Vol. XVI No. 5

DISSERTATION ABSTRACTS

ABSTRACTS OF DISSERTATIONS AND MONOGRAPHS IN MICROFORM

UNIVERSITY MICROFILMS
ANN ARBOR, MICHIGAN: 1956

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INTRODUCTION

This year for the first time *Dissertation Abstracts* will carry, as the 13th issue of Volume XVI, an index to all doctoral dissertations published in the United States and Canada. This issue will be titled *Index to American Doctoral Dissertations*, and will be a continuation of *Doctoral Dissertations Accepted by American Universities.*[1] The joining of these two reference works makes it possible for librarians to have an integrated bibliographical research tool relating to doctoral dissertations under one cover.

Dissertation Abstracts will continue to provide abstracts of dissertations by recipients of doctoral degrees from graduate schools cooperating with University Microfilms in the publication of complete dissertation texts on microfilm, on Microcards, or as microprint. At the end of each abstract will be found an indication of the number of pages in the original typescript and the Library of Congress card number, for the convenience of scholars and research workers. In some instances *Dissertation Abstracts* will be found to be an adequate substitute for the published dissertations.

The *Index to American Doctoral Dissertations* will be a complete indexed listing of dissertations by students who were granted doctoral degrees during the previous academic year, and including those abstracted in *Dissertation Abstracts*, arranged by degree-granting institutions under appropriate subject headings. An alphabetical author index will be included.

The tabular material which has been an established part of its predecessor volume will be included in full, so arranged that statistical summaries can be maintained with no break in continuity.

It is hoped that those who use *Dissertation Abstracts* will continue to make suggestions for its improvement, as these are vital to its continued life and growth. Several suggestions for changes in the headings used for indexing purposes have been received, and a committee of the Association of Research Libraries is reviewing the indexing system at the present time as a result of these suggestions.

[1]Arnold H. Trotier and Marian Harman, (eds.), *Doctoral Dissertations Accepted by American Universities.* (New York: H. W. Wilson Co., 1933-1955.)

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AGRICULTURE, GENERAL

CATION EXCHANGE MECHANISMS IN SOIL MINERAL AND ORGANIC COLLOIDS

(Publication No. 16,157)

Lawrence E. DeMumbrum Jr., Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor M. L. Jackson

The cation exchange capacities of soil colloidal electrolytes vary with the type of ion employed in the measurement, being larger when measured with cations of weak bases. In order to investigate the mechanism underlying those variations, four techniques were employed. Cation exchange capacity measurements were made at a series of pH values. An infrared absorption technique was used to investigate changes in layer silicate and peat spectra caused by cation saturation. Titration curves of montmorillonite and peat were obtained by addition of weak and strong bases to the acid saturated colloidal electrolytes. Exchange equilibria were effected in neutral solution by use of slightly soluble copper and zinc precipitates as cation sources and subsequent diffusion of ions from these compounds to the exchangers, through semi-permeable membranes.

The cation exchange capacity of California montmorillonite as measured by calcium, copper and zinc was 110, 120 and 114 meq/100 gm respectively, or an additional increment of about 10% for copper and 4% for zinc. Examination of the infrared absorption spectrum of montmorillonite showed that a reaction occurred between copper or zinc and structural hydroxyls of the montmorillonite, causing a decrease in the 2.8 micron hydroxyl peak. A similar change resulted in the vermiculite and kaolinite spectra, with additional absorption peaks resulting at 6.4 and 7.0 microns in montmorillonite and vermiculite as a result of copper saturation. In titration curves of montmorillonite, significantly more $Cu(OH)_2$ was required per unit rise in pH than was required for the other bases. It was shown that appreciable amounts of copper and zinc were exchanged by montmorillonite from very dilute neutral solution, and that the presence of large excesses of calcium failed to inhibit the exchange of the special increment of copper or zinc. Hydrogen was shown to be released to solution upon treatment of montmorillonite with copper, concurrent with the above noted decrease in hydroxyl intensity.

In peat, the additional increment of cation exchange capacity measured by copper and zinc was about 40% (150 meq/100 gm by Ca or K and 210 meq/100 gm by Cu or Zn). Infrared examination of four peat fractions showed several shifts in the double bond region of the spectra as a result of copper and zinc saturation and were attributable to copper or zinc interaction with C=0 or N=0 groups. Weak hydroxides were shown to react with acid peat in much larger equivalent amounts than did strong bases. Copper and zinc were sorbed by peat in moderate amounts from very dilute neutral solutions. A special increment of the exchange was occupied by these ions, concurrent with full saturation by calcium.

In several soils of varying organic matter content, copper and zinc measured an additional increment of exchange capacity, with the amount of the excess increasing with organic matter content. In addition, the infrared spectrum of the Spencer colloid was altered by treatment with copper, showing a reaction mechanism similar to that observed in the standard layer silicate clays.

The conclusions reached follow:

First. Montmorillonite and soils show an increment of exchange which is specific for copper and zinc.

Second. The mechanism by which this special exchange increment arises in layer silicate clays is shown to be embodied in the reaction of copper and zinc with structural hydroxyls.

Third. Peat shows an increment of exchange which is specific for copper and zinc.

Fourth. It is postulated that chelation of copper or zinc by the peat gives rise to this exchange increment.

The fact that copper and zinc can accumulate in exchangeable form, even in neutral systems, appears to be highly significant in explaining the mechanism by which copper and zinc become available to plants in neutral or slightly alkaline soils. 75 pages. $1.00. Mic 56-1299

A PLANNING TECHNIQUE FOR FARMERS' INSURANCE NEEDS

(Publication No. 16,467)

John Edward Greenfield, Ph.D.
Purdue University, 1956

Major Professor: J. H. Atkinson

Certain relationships found in an earlier study between personal and financial factors and the amount of insurance carried were tested with multiple correlation analysis to determine the extent to which these factors accounted for variations in the amount of insurance carried by Indiana farmers. The results were low correlations. This indicated that it was not readily apparent what factors affected the amount of insurance carried by farmers and-or the nature of their effect. These factors and their effects should be known for intelligent insurance planning. The determination of the proper factors and how they should be used in insurance planning was the problem investigated in this study. Only insurance protection was considered. The investment aspects of life insurance were omitted.

A theoretical solution to the problem was developed. The proposed model assumed that all goals, that could be protected by commercial insurance, could be expressed as future incomes. Goals may include sending the children

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to college, keeping the farm unit intact, maintaining a desired standard of living, and others. All desired future incomes were converted to their present value at a conservative rate of interest. For a short run outlook the various kinds of commercial insurance were ranked according to cost per dollar of protection. In the short run the individual would be interested in minimizing his immediate cash outlay for insurance premiums. For a long run outlook they were ranked according to administrative costs. In the long run the individual would be interested in minimizing his cash outlay for insurance premiums over many years in the future. Depending upon which outlook was chosen by the individual, the person's net worth was earmarked to cover as many insurable risks as possible, beginning with the most expensive and proceeding to the least. The necessary amount of protection for each risk was the extent to which the individual's net worth would be reduced if the loss occurred. In the case of life and disability insurance, the necessary amount was the discounted future incomes desired. Whatever risks could not be protected by net worth were protected by commercial insurance. Net worth cannot be substituted for liability insurance. When liability insurance comes up for substitution, according to its rank, the substitution process ends and liability insurance is carried in all areas to protect the net worth already used to substitute for other kinds of insurance.

This model was tested partially by applying it to eight case study situations. The cases were analyzed according to the suggested theory and the results were returned to the farmers for comment.

Remarks by the cooperating farmers indicated general acceptance of the reasoning used in the theoretical model. The general application of the conclusion was limited since it was based on only eight observations. Lack of general insurance knowledge was apparent and several minor criticisms of the method and presentation were made. The premiums for the proposed insurance programs were not greatly in excess of the premium the cooperators were already paying. In some cases the proposed premiums were less. Only one individual selected a goal requiring far more premium than he was currently paying. The most common discrepencies between present and proposed insurance programs were that present liability limits were not high enough, disability insurance was not carried by any farmers, and amounts of life insurance were too low to protect desired goals.

Several areas for further research were suggested and some interesting implications for the insurance industry were suggested. This study represents a method for planning needs for all kinds of commercial insurance, protecting a minimum goal against the maximum number of commonly insurable risks. 199 pages. $2.49. Mic 56-1300

BIONOMICS OF THE CLOVER LEAF WEEVIL, HYPERA PUNCTATA (FABRICIUS)

(Publication No. 16,415)

Moufied Abdel-Aziz Moussa, Ph.D.
University of Illinois, 1956

I. INTRODUCTION

The clover leaf weevil is a pest of variable, local significance on alfalfa and clovers. When it occurs abundantly, it may defoliate a crop or so weaken a stand that competitive plants replace it in a meadow. Causes for spotted distribution of populations and relative rates of destruction have been only partially explained. Their explanation would be helpful in enabling growers and field entomologists to plan specific programs for suppression of the pest thereby avoiding the present random, indiscriminate application of toxicants.

Observations related herein began as a result of an earlier effort to survey populations of noxious insects in fields of forage crops. The literature showed that bionomic knowledge about the clover leaf weevil was fragmentary, and little was known about it as populations. At the time, this insect was very abundant locally thus providing an opportunity to observe various aspects of its bionomics. Fortunately, also, numerous sites for its study were near at hand.

Most of the detailed observations were made in the laboratory of the Department of Entomology as well as in fields of alfalfa and red clover on farms of the Department of Agronomy of the University of Illinois within Champaign County, Illinois.

All linear measurements are stated in the metric system. Temperatures are given on the Centigrade scale.

II. SUMMARY

1. Alfalfa and red clover are primary hosts of the clover leaf weevil, although some 18 hosts have been reported. Of the two primary hosts, red clover is preferred.

2. Methods of assessing densities of populations of all stages, in all seasons and in different environments have been devised, applied and evaluated. These methods involve

   a. Sampling of populations by means of randomly distributed areas of 900 cm^2 in fields, and

   b. Collecting certain stages above ground by means of samples taken by 100 sweeps of a net while traversing each area.

3. Methods of assessing effects of populations of larvae of this species on yields of alfalfa and red clover have been devised, applied and evaluated. These methods are based on

   a. Natural defoliation based on the average amount of foliage consumed by an individual larva each day according to age and rate of development, and

   b. Artificial defoliation of the plants in the fields at the same rate of feeding as various populations of larvae.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

4. Information obtained on the seasonal history of this species in central Illinois indicated that

   a. This weevil completes only one generation a year, but it may have two broods a year, and

   b. Considerable over-lapping of stages of development of the weevil may occur at times, and

   c. Populations of this species are most abundant in the fall as eggs and in the spring as larvae, and

   d. Populations of this species survive the winter in the egg stage and to a small extent in the larval and adult stages; and that only eggs with partial or complete development are able to withstand cold weather.

5. Factors favorable to abundance of this species vary with stage of development involved as

   a. A high density of population of eggs occurs where a thick coverage of plant residue (fragments of stems) is present on soil surface, and

   b. A high density of population of larvae occurs where a higher stand count is found in the fields, and

   c. A high density of population of adults occurs where large amounts of plant residue are found on soil surface.

6. Factors detrimental to populations of this weevil are biological and climatological. The biological factors affect populations of the immature stages while the climatological ones affect population of adults. The degree of suppression of the populations by these factors have been also evaluated. In this respect it was found that

   a. Populations of eggs declines because of mortality of eggs by all natural enemies amounting to 20 per cent of the total population of eggs; the fungus Aspergillus parasiticus Speare contributed 2 per cent of the total mortality while the predaceous mite Asca sp. contributed about 7 to 10 per cent mortality, and

   b. Population of feeding larvae declines when attacked by the fungus Empusa sphaerosperma (Fres.) causing about 7 to 11 per cent mortality; also about 20 to 30 per cent of total population of larvae died after spinning of cocoons apparently due to attack of a dipterous parasite, and

   c. Population of adults declines at a rate of about 12 to 28 per cent due to failure of adults to survive the climate during the summer.

7. In addition to the previous findings, the following ones are reported here for the first time.

   a. First record of eggs of this weevil as hosts of the parasitic fungus Aspergillus parasiticus Speare, and

   b. First record of the mite Asca sp. (undescribed) as predator on the eggs, and

   c. First record of mortality of a larva by a dipterous parasite. 115 pages. $1.44. Mic 56-1301

EXCHANGE STUDIES OF P^{32} AND P^{31} IN PLANTS

(Publication No. 14,508)

Tzu-liang Yuan, Ph.D.
The Ohio State University, 1955

The exchange of isotopes of the same element between plant roots and the culture medium has been observed by a number of investigators. The author, by using the stable isotope of phosphorus P^{31} and its radioactive isotope P^{32}, has attempted to determine if a similar exchange reaction occurs within the plant and if so, of what significance it may be in plant research utilizing tracer techniques.

The investigation reported was conducted in a greenhouse with corn, tomato, and soybean plants grown in gravel, gravel-sand, and sand cultures respectively. Different treatments, including different ratios of P^{32} and P^{31}, and different concentrations with the same ratio of P^{32} and P^{31}, were introduced into the mineral nutrient solutions when the plants were entering the early stage of maturity. The plants were harvested and dissected into different tissues approximately two weeks after the treatments were made. The P^{31} content and the radioactivity of P^{32} in the tissues were determined, the results being expressed as micrograms and counts per minute per unit weight of sample respectively.

The results indicate that an isotopic exchange between P^{32} and P^{31} took place. The P^{32}:P^{31} ratios in various plant tissues were approximately the same despite the fact that there was previous accumulation of P^{31} which varied widely in the different tissues. It appears that P^{32} exchanges not only with P^{31} in the plant in inorganic or unassimilated form but also with that in various complex organic forms. It is suggested that the exchange must be intermolecular and interionic in nature.

The results also show that the amount of phosphorus previously accumulated may have an effect on the amounts of P^{32} and P^{31} absorption but has no effect on their ratio. However, the content of previously accumulated P^{31} in a particular tissue has a definite effect on the amounts of P^{32} and P^{31} and the ratio of these later accumulated in that tissue. The data show that during the treatment period the P^{32} and P^{31} accumulated in different tissues varied widely, although the total uptake of P^{32} and P^{31} by the plant during that period had a ratio the same as that in the mineral nutrient solution.

A reduced P^{32}:P^{31} ratio was observed in the mineral nutrient solution at the end of the treatment period. The reduced ratio probably resulted from the adsorption of a larger proportion of P^{32} in relation to P^{31} on the wall of the container and the connecting tubes in the irrigation system. When there was P^{31} fixed in the gravel or in the sand previous to the P^{32} - P^{31} treatments, at least the surface exchange of P^{32} with P^{31}, fixed in insoluble form, may also have contributed to the reduced P^{32}:P^{31} ratio in the solution.

The results of this study indicate that the concentration of the carrier of the radioactive isotope in the culture medium and the previous accumulation of the carrier in the plant must be taken into consideration in evaluating quantitatively the absorption of phosphorus in soil fertility and plant nutritional studies.

92 pages. $1.15. Mic 56-1302

AGRICULTURE, ANIMAL CULTURE

UTILIZATION OF INORGANIC PHOSPHATES BY RUMINANTS

(Publication No. 16,377)

Clarence Bailey Ammerman, Ph.D.
University of Illinois, 1956

Steers, lambs, and chicks were used to ascertain the relative availability of the phosphorus in various inorganic phosphatic materials. Ruminant utilization of the phosphates was studied, using phosphorus balance and inorganic blood phosphorus levels as criteria.

Yearling steers were used in an experiment designed as a 6 x 6 Latin square. The steers were fed approximately 1.70 grams of phosphorus per cwt. daily, 50 percent of which was supplied by the inorganic phosphatic material being tested. Two commercial dicalcium phosphates and one each of bone meal, defluorinated phosphate, Curacao Island phosphate and soft phosphate with colloidal clay yielded average total phosphorus retention values of 33, 31, 30, 29, 25 and 28 percent, respectively (not significantly different). In a later test with the same steers, one of the dicalcium phosphates was compared with another sample of defluorinated phosphate. Similar phosphorus retention values were obtained. Blood phosphorus levels remained normal for all steers in both tests and did not appear to be affected by treatment.

Young weanling lambs were depleted of phosphorus stores by feeding a semi-purified ration containing about 0.03 percent organic phosphorus for about four weeks. Following depletion, supplemental phosphorus feeding and fecal collections were begun simultaneously and continued for 12 days. The supplemented rations contained 0.13 to 0.16 percent phosphorus. Results obtained during the last six days of collection indicated that of the four phosphatic supplements tested, dicalcium phosphate and Curacao Island phosphate were well utilized but that soft phosphate and defluorinated phosphate were significantly less well utilized (P = 0.01-). Average total phosphorus retention values for the four samples were 40, 38, 13 and 11 percent, respectively. Blood serum inorganic phosphorus levels, expressed in milligrams per 100 ml., rose during the 12-day repletion period for the supplements listed above by average amounts of 2.4, 2.6, 1.3, respectively (not significantly different). When monocalcium phosphate, calcium metaphosphate and calcium pyrophosphate were compared with young lambs in an experiment similar in design to that described above, average total phosphorus retention values obtained for the entire 12-day collection were 26, 0, and -21 percent, respectively. The response from each treatment differed significantly (P = 0.02-) from that of the other two. Blood phosphorus levels improved by average values of 2.5, 1.2, and 0.7, respectively. These values were significantly different at the two percent level.

Various samples of the phosphatic materials were assayed with chicks, using percent tibia bone ash as the criterion. Day-old chicks were fed a basal diet containing about 0.2 percent organic phosphorus for four days following which supplemented diets containing graded levels of phosphorus from the various sources were fed for six days. Compared with the bone ash response obtained with monosodium phosphate, which was considered to be 100, the phosphates yielded values as follows: Two dicalcium phosphates, 74 and 82; bone meal, 74; two defluorinated phosphates, 62 and 32; Curacao Island phosphate, 54; soft phosphate, 49. The defluorinated product which yielded a value of 32 with chicks was the same sample which gave a poor response in the lamb work.

86 pages. $1.08. Mic 56-1303

YEARLY ENVIRONMENTAL AND GENETIC CHANGES IN THE YIELD OF FAT CORRECTED MILK WITHIN A DAIRY HERD FROM 1901 TO 1954

(Publication No. 16,388)

Willard Milo Dillon, Jr., Ph.D.
University of Illinois, 1956

Maximum likelihood estimates of the yearly environmental and genetic changes that occurred within the University of Illinois dairy herd were based on a method developed by C. R. Henderson. The 1,164 cows from the Ayrshire, Brown Swiss, Guernsey, Holstein, and Jersey breeds made 3,411 records that were studied. The accuracy of this method was found to depend on the use of age correction factors that are not greatly biased by environmental or genetic trends.

In this herd, the environment improved markedly until about 1915, then a slight downward trend started. This decline has become more pronounced since the end of World War II. The correlations between the yearly environmental changes, estimated for each breed, indicate that these changes affect all breeds in a similar way.

The breeding program followed in this herd has resulted in some improvement in the average real producing ability of all except the Holstein cows. This improvement has been less rapid during the latter years of this study, indicating that further progress under a breeding program of this type (basically a mental evaluation of the information that is considered to be important in deciding which animals to cull and which to purchase) may be difficult to obtain. In the Holstein herd the average equal parent index, independent of yearly environmental change, for the 19 homebred sires was 535 pounds of FCM above the average index of the 18 purchased sires. This would indicate that greater use of homebred sires in this herd would probably have resulted in some improvement in the average real producing ability of the Holstein cows.

The error variance associated with this model decreased as repeatability increased and ranged between 54 and 76 percent of the variance of the standardized records. The standard deviation of the estimated real producing ability for each cow varied between 787 and 1,217 pounds of FCM; moreover, the standard deviation from regression of the yearly genetic changes, a measure of the standard deviation of the average real producing ability of the population from which males and females are selected in any one year, ranged from 769 to 960 pounds of FCM. The standard deviation from regression of the yearly environmental changes, a measure of the yearly environmental standard deviation that may be expected in any one year, ranged from 585 to 871 pounds of FCM.

The results of this study, based on age-corrected records, should be compared with a similar analysis based

on FCM production per 1,000 pounds of weight in an effort to evaluate the relative reliability of the two methods.

51 pages. $1.00. Mic 56-1304

ESTIMATES OF GENETIC PARAMETERS NECESSARY FOR CONSTRUCTING SELECTION INDEXES FOR BEEF CATTLE

(Publication No. 16,391)

Lee Evans, Ph.D.
University of Illinois, 1956

Beef cattle improvement through selection and breeding depends upon the relative value of the factors used in selection and the mating system used in the herd. Accurate measures of merit should be used so as to properly evaluate the economic worth of the individual animal.

The economic value of an animal is determined by the combined influence of several factors. Since all of these factors usually need improvement, the most efficient method is by use of a rating system that will give proper emphasis to the traits in which improvement is desired; such a rating system is known as an index.

Genetic factors which are necessary for constructing a selection index are heritability estimates, variance components and correlation coefficients between the traits. These parameters were determined for birth weight, weaning weight, weaning condition score, weaning type grade and yearling weight on 1737 calves.

Adjustments were made for differences in age of calves at the time of obtaining weaning weights and yearling weights by use of regression equations following the methods of Whatley and Quaife (1937) and Johnson and Dinkel (1951). The regression equation, $Y = 167.4 + 1.0503X$ was obtained for weaning weights and the regression equation, $Y = 189{:}3 + -.9289X$ was obtained for yearling weights. The prediction equation for corrected weaning weights was $Y = \frac{369W}{X + 159}$ and for corrected weaning weights was $Y = \frac{804W}{X + 204}$, where Y is the age corrected weight; X is the actual age; and W is the actual weight at age X.

After adjusting for age differences the data were classified according to sex and age of calf, age of dam, year of birth, sire, and whether purebred or grade. All analyses were on a within-subclass basis. Heritability estimates for the various traits were computed from regression of offspring on dam. Genetic correlations were computed by the method proposed by Hazel (1943). The genetic parameters which were computed may be used along with the relative economic value of each trait to calculate a selection index.

CONCLUSIONS

1. Differences in the performance of beef calves due to sex and age of animal and age of dam should be adjusted for before comparing different animals.
2. Heritability estimates for the 5 traits studied indicate that there is sufficient genetic variability within these traits to make progress by selection.
3. The high phenotypic and genetic correlations indicate a close relationship between these traits and a close association of the genes influencing them.
4. The results of this study should be adaptable to beef herds of similar environment and the information would be most useful through a selection index using the genetic parameters and setting up relative economic values for each trait.

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52 pages. $1.00. Mic 56-1305

SKELETAL MALFORMATION AND BONE HISTOLOGY OF YOUNG RABBITS FED TOXIC LEVELS OF MOLYBDENUM

(Publication No. 16,361)

Harry Franklin Roberts, Ph.D.
The University of Florida, 1956

Experiments were conducted to study the manifestation and some of the factors affecting molybdenum toxicity in young rabbits. A total of 48 immature rabbits were fed molybdenum in a simplified diet. A toxic syndrome was produced which was characterized by alopecia, retarded growth, diarrhea, abnormal bone formation and dermatosis.

Retarded growth was evident in rabbits receiving either 0.1 or 0.2 percent levels of molybdenum. Feed intake was reduced in both groups but only after characteristic toxic symptoms developed. At the beginning feed consumption was not different from that of the animals receiving the basal ration. Death resulted within 4 weeks in all of the animals receiving the 0.2 percent level of molybdenum and the animals receiving the lower level of molybdenum in approximately 7 weeks. Symptoms appeared somewhat later in rabbits receiving the lower level of molybdenum. The higher level of molybdenum caused symptoms to appear earlier and to become severe at an earlier stage, but the nature of the abnormalities was identical on each level of molybdenum.

Calcium, phosphorus and total ash in the bones were not affected in animals receiving either level of dietary molybdenum.

Histological studies of microscopic sections of bones from rabbits which exhibited macroscopic deformities showed that the bone disorder consisted of a diffuse osteoporosis, with no primary disturbance in the calcification mechanism. Absorption of the bone with a subsequent thinning of the inner portion of the cortices and also into the shaftward portion of the metaphysis was observed in the animals receiving both levels of dietary molybdenum. Generalized necrosis existed in the subperioestral region of animals which exhibited symptoms of molybdenum toxicity. The superficial growth occurring on the radius and ulna proved to be excessive cartilagenous material with no osteogenic activity. 63 pages. $1.00. Mic 56-1306

STUDIES OF REPRODUCTIVE CYCLES AND FERTILITY IN EWES

(Publication No. 15,289)

Stephen Morris Williams, Ph.D.
University of Illinois, 1955

In spite of the fact that the physiology of reproduction of the ewe has been extensively studied, many contradictory findings have been reported and there are still many aspects yet to be investigated.

Mean Breeding Dates and Environmental Temperature.

The average gestation lengths were subtracted from the mean lambing dates of four breeds in the University flock for each year 1921-1953. This provided the mean breeding dates for each of these years. These latter were correlated separately with maximum, minimum and mean temperature during the preceding Summer months. Monthly averages of temperature were used and also the temperatures at specific time intervals before each breeding date. Almost all the correlations were nonsignificant showing that fluctuations in Summer temperature from year to year had little if any influence upon the time of the subsequent breeding season.

An analysis of the mean lambing dates of these four breeds showed that Hampshires were usually the earliest, followed by Rambouillets a week later and then Shropshires and Southdowns together a month afterwards. However, their relative order changed somewhat from year to year.

Estrous Cycles and the Breeding Season.

Nonparous Western ewes were continuously checked for estrus from Spring, 1951 to Fall, 1953 by use of raddled vasectomized rams. Information was thus provided on the onset and end of the breeding season and also on estrous cycle length throughout the breeding season. The 1951 breeding season began much earlier and lasted longer than those of 1952 and 1953. In most cases the ending dates of one breeding season had no influence upon the onset dates of the next. Excepting one small group of ewes, there was no trend for individual ewes to be consistent from year to year with regard to onset, duration and end of their breeding seasons.

A high percent of estrous cycles occurring during the Summer months and also in later Winter and Spring were of abnormal length i.e. over 19 days and under 14 days. However, a few abnormal length cycles occurred throughout the breeding season.

Fertility and Ovarian Characters.

In 1953 all the Western ewes were bred to fertile rams at the first, second and third estrus periods of the breeding season. Half of the ewes in each group were slaughtered and examined after approximately 4 days and the other half after approximately 25 days after breeding. In terms of ovulation rates, unfertilized ova, live and dead embryos there was a plateau of fertility during the first 3 estrous periods but a progressive decrease in rate of fertilized ova occurred. There was a high rate of reproductive wastage in the ovum stage and a low rate in the embryo stage.

Other characters studied were: ovarian weight, embryonic migration and right and left ovarian activity.

A scattering of slaughtering times enabled the following conclusions to be drawn: follicle numbers increased during the first 18 days of pregnancy, thereafter until 120 days the numbers remained constant but the size gradually decreased.

Histological examination of corpora lutea revealed that they had a functional appearance throughout the part of pregnancy observed (0-120 days).

Estrus during Pregnancy.

The occurrence of estrus during pregnancy was recorded with the Western ewes and also with Rambouillets which were pregnant during the Summer and again during the following Winter. The percent of these ewes showing estrus ranged from 8-62. Almost all of the estrous periods occurred during the normal breeding season. Ovulation did not accompany estrus during pregnancy.

122 pages. $1.53. Mic 56-1307

AGRICULTURE, PLANT CULTURE

THE MITSCHERLICH EQUATION AS APPLIED TO EXPRESS THE RELATIONSHIPS BETWEEN PLANT COMPOSITION AND THE SOIL NUTRIENTS

(Publication No. 16,379)

Abd El Monem Balba, Ph.D.
University of Illinois, 1956

When phosphorus was added to deficient soils in different increments, the per cent phosphorus in wheat grain increased. The relationship between the phosphorus composition of the wheat grain and that added to the soil may be expressed by a Mitscherlich type equation as follows:

$$y = 0.583(1 - e^{-0.033\,b\ -\ 0.0027\,x}) \qquad \text{Ia}$$

where y is the per cent phosphorus in wheat grain when b pounds of phosphorus, as measured by the soil P_2 test are present in the soil, and x pounds of P_2O_5 per acre are added as fertilizer. The value of 0.583 is the maximum per cent phosphorus in the grain.

A detailed discussion of the significance of each term in the original Mitscherlich equation is presented. The writer concluded from this discussion that b in the original equation represents the total soil nutrient supply and thus could be substituted by the amounts of more than one form of the nutrient in several layers of the soil. Thus $cb = (c_{a1}B_{a1} + c_{a2}B_{a2} + \ldots + \ldots + c_{ak}B_{ak} + c_{b1}B_{b1} + c_{b2}B_{b2} + \ldots + c_{bk}B_{bk} + \ldots + c_{n1}B_{n1} + \ldots + c_{nk}B_{nk})$ where a - n designates the several forms of the nutrient and 1 - k designates various depths of soil in the root zone.

Also this discussion considers the applicability of using the efficiency factors, the c's in the equation, when the equation expresses the nutrient-plant composition relationships, as quantitative measures of the effectiveness of one form relative to another, or of a given form under different conditions. The Equation Ia was, therefore, expanded to

$$y = 0.583\ (1 - e^{-0.00448\ B_a\ -\ 0.000188\ B_b\ -\ 0.00617\,x}) \qquad \text{Ib}$$

where B_a, and B_b are the adsorbed and dilute acid-soluble forms of soil phosphorus in an acre 2-foot depth, and x is pounds of added phosphorus (P) per acre. Using the concept

of the relative effectiveness, it was concluded that fertilizer phosphorus was 1.4 times as effective as the adsorbed form, and 33 times as effective as the dilute acid-soluble form of the soil phosphorus.

The formula $\frac{cx}{cb + cx}$ was derived from the exponential form of the original Mitscherlich equation to determine the proportion of the total nutrient taken by the plant that came from the fertilizer source.

The equation, $y = 15.17(1 - e^{-0.02\,b\,-\,0.0084\,x})$ IIa

expresses the relationships between total plant uptake of phosphorus to soil nutrient. The equation was further expanded to:

$y = 15.17(1 - e^{-0.0106\,B_a\,-\,0.00049\,B_b\,-\,0.0084\,x})$ IIb

to include the adsorbed and dilute acid-soluble forms of the soil phosphorus B_a and B_b. The following formulas were derived from Equation IIb, to give the proportion of nutrient in the plant taken up from the different sources:

1. The fertilizer = $\frac{cx}{c_aB_a + c_bB_b + cx}$
2. The adsorbed form = $\frac{c_aB_a}{c_aB_a + c_bB_b + cx}$
3. The dilute acid-soluble form = $\frac{c_bB_b}{c_aB_a + c_bB_b + cx}$

The amounts of phosphorus taken up by the plant from each form was then calculated. The results are in general agreement with results obtained by other authors using P_{32} techniques. The above equation permit calculation of the contribution of each soil form which cannot be obtained by the radioactive techniques.

The data also show that the per cent potassium in the grain increased with increasing additions of phosphorus. The nitrogen decreased in the grain and straw on fertilized plots. The calcium percentage remained constant.

119 pages. $1.49. Mic 56-1308

THE EFFECT OF ORGANIC MATTER ON THE RETENTION OF ZINC BY THE SOIL

(Publication No. 16,447)

Newton Moore Baughman, Ph.D.
Purdue University, 1956

Major Professor: S. A. Barber

The hypothesis was tested, using zinc as the test element, that the cationic micronutrients in the soil are bound in chelate form with some component of the soil organic matter and that chelate formation affects the availability of these ions to plants.

Two thirds of the total zinc content of the Maumee soil was shown to be associated with the organic matter by fractionating the total zinc content into exchangeable, organic, and residual forms. Fractionation of the zinc content of the Floyd soil into the same fractions showed that almost half of the total zinc of this soil was associated with organic matter.

Zinc added to a Maumee soil was found to be held in three forms; exchangeable zinc which was extracted with ammonium acetate, chelated zinc which was subsequently extracted with copper acetate and strongly complexed zinc which was not extracted by either ammonium or copper acetates. Dithizone, a competing chelating agent, removed the same quantity of zinc as copper acetate. When the organic matter was removed by oxidation with hydrogen peroxide all of the added zinc was recovered by dithizone extraction.

The amount of chelated zinc which was replaced from both soils by a series of divalent cations, capable of chelate formation, was in proportion to the stability constants of these cations with known chelating agents. No preferential replacement of zinc was shown by these ions when organic matter was removed from the soils.

Larger amounts of zinc were retained by the soil containing the greater percentage of organic matter. Little difference was detected between the amounts of zinc retained by these soils when organic matter was removed.

The amount of zinc that was fixed by the Maumee soil and not replaced with copper was dependent upon the pH of the suspension. Complete recovery of zinc occurred at a pH of 2.5 - 3.0. The minimum recovery occurred at pH 7. The chelated zinc, that replaced by copper, was not appreciably affected by pH.

Chelation of copper and zinc by the organic matter was also indicated by potentiometric titration of silver saturated clay and soil with the chlorides of potassium, hydrogen, copper, and zinc. Silver was replaced by these cations in the order of their tendency to form chelates.

The results of these experiments indicate that chelation is a factor influencing the retention of zinc by soils. From the plant nutrition aspect, chelation may be quite important in reducing zinc availability where total supplies of zinc are low or where soils are high in organic matter.

96 pages. $1.20. Mic 56-1309

THE EFFECT OF SOIL PHOSPHORUS COMPOUNDS ON SOIL TEST CORRELATION

(Publication No. 16,448)

William Delphin Bishop, Ph.D.
Purdue University, 1956

Major Professor: Stanley A. Barber

The effect of soil phosphorus compounds on soil test correlation was investigated on twenty soils representing the II and VIII profiles of the Upland and Lake Plain catenas. The plant available soil phosphorus was determined by experiments which gave values for yield of phosphorus and percent yield. The soils were characterized by the determination of a number of physical and chemical properties. These physical and chemical determinations were used as independent variables in a multiple correlation analysis with both yield of phosphorus and percent yield as dependent variables. The independent variables consisted of pH, organic matter, clay content, acid soluble phosphorus, water soluble phosphorus, alkali soluble phosphorus, organic phosphorus and iron content.

When all eight independent variables were included in a multiple correlation analysis using yield of phosphorus

as the dependent variable a multiple correlation coefficient of 0.931 was calculated. However, by eliminating all variables but acid- and alkali-soluble phosphorus, the multiple correlation coefficient was 0.851. The simple correlation coefficient for acid soluble phosphorus was 0.557 and for alkali soluble phosphorus 0.675. The increase in correlation where both acid- and alkali-soluble phosphorus were used over the correlation for either one alone was highly significant at the 1 per cent level. However, the inclusion of all eight independent variables did not significantly increase the correlation over that obtained for acid- and alkali-soluble phosphorus.

Solubility curves of the twenty soils indicated that the soils were heterogeneous with respect to soil phosphorus compounds. These differences were found to be due to soil forming factors rather than to parent material. Soils of the VIII profile from the Lake Plain catena contained more calcium phosphate compounds in relation to iron or aluminum phosphate compounds. The soils of the VIII profile from the Upland catena contained more iron and aluminum phosphate compounds than the soils of the Lake Plain catena. This was further supported by evidence gathered from a greenhouse experiment where soils of the VIII profile from both catenas were acid treated. Acid treating soils from the Upland catena caused a decrease in yield. Acid treating soils from the Lake Plain catena caused a slight increase in yield.

Solubility curves for calcium phytate and other organic compounds suggest that these compounds are acid soluble, indicating that an acid extraction represents phosphorus from both organic and inorganic forms. This was supported by the fact that a significant correlation was obtained between organic matter and acid soluble phosphorus.

The presence of lepidocrocite in some of the soils investigated was established. However, no relationship was found between its presence and catena or drainage profile. The importance of lepidocrocite was not established.

The evidence indicated that the total available phosphorus in soils depended on the type and amount of soil phosphorus compounds present. Soils which were heterogeneous with respect to types of phosphorus compounds could not be compared satisfactorily by using either an acid or an alkaline extraction. Rather, the use of both was required to explain the contribution of the different soil phosphorus compounds to yield.

93 pages. $1.16. Mic 56-1310

FACTORS AFFECTING THE METABOLISM OF GREENHOUSE PLANTS WITH SPECIAL REFERENCE TO CHRYSANTHEMUM MORIFOLIUM

(Publication No. 16,454)

Norman Wesley Butterfield, Ph.D.
Purdue University, 1956

Major Professor: Dr. Ruble Langston

The history of development, construction, principles of operation and uses for the infra-red gas analyzer for detecting minute quantities of carbon dioxide content of the air were presented.

The infra-red gas analyzer was found to be very sensitive and accurate for the research undertaken. An internal air circulation pump was designed which was of value for physiological studies. The construction of a water cooled plexiglass chamber proved to be of value for the photosynthetic studies. In examining the absorptive qualities of potassium hydroxide for carbon dioxide in air streams it was found to be very poor, especially at low concentrations. As the rate of flow of air increased, the rate of absorption of carbon dioxide decreased. It was apparent that the only material that would absorb carbon dioxide from an air stream was a suitable soda lime tower. Under a given set of conditions its effectiveness persisted for 48 hours.

Plants of Chrysanthemum and Xanthium when induced photoperiodically have no apparent net fixation of carbon dioxide as examined by the technique of analyzing the air as it passes over the plant with the infra-red gas analyzer. Two varieties of Chrysanthemum, Indianapolis Pink and Bluechips, when induced exhibit an increase in respiration rate. This increase of respiration rate was particularly evident as a result of the first and third inductions.

Whole Xanthium plants having four leaves, attached leaves and young excised leaves showed an increase in respiration rate when induced. Fairly matured leaves, when induced were found to have a decreased respiration rate.

The effects of wilting on the rate of photosynthesis for the Chrysanthemum were studied. The data indicate that during the early stages of wilting, the plant exhibits an increase in photosynthetic rate. This increase is not of long duration. When the plant reaches the stage of temporary wilting the photosynthetic rate was greatly reduced and regardless of whether water was added or not the plant did not return to its normal apparent photosynthetic rate during the period it was studied.

Plants of Bryophyllum were studied and the data show that this plant exhibits strong powers for fixation of carbon dioxide during the night. The chemical changes taking place at night are well known, but this is the first time that a graphic pattern of carbon dioxide fixation for the Bryophyllum has been demonstrated. The data show that light is essential for the dark fixation of carbon dioxide. The duration of light for fixation of carbon dioxide was studied but no thresholds were established.

137 pages. $1.71. Mic 56-1311

RESISTANCE TO PYTHIUM SEEDLING BLIGHT OF MAIZE

(Publication No. 16,458)

Paul Levi Crane, Ph.D.
Purdue University, 1956

Major Professor: Dr. Herbert H. Kramer

Studies were conducted on both the genetic and pathological characteristics of resistance in germinating corn seedlings to Pythium ultimum Trow. Evidence was found that a portion of the resistance resides in the maternal pericarp tissues and a portion is within the germinating embryo. The two are distinct and genetically independent. When the F_2s from reciprocal F_1s and backcrosses using

reciprocal F_1s as maternal parents were compared, no evidence of cytoplasmic influence on resistance to Pythium ultimum was found.

The ear to ear variation of seedling survival in muck soil at 50° F. was found to be closely associated, inversely, with the quantity of sugars which would leach from a sample of kernels into distilled water in 5 days at 50° F. This in turn was positively correlated with the free reducing sugars in the kernel at the outset. The high correlations within pedigrees where little if any segregation is occurring between ears indicates that variation in sugars leached, and the associated inverse variation in seedling survival, arises from environmental influences on the maternal plant. 59 pages. $1.00. Mic 56-1312

THE EFFECT OF ORGANIC MATTER ON SOIL AERATION WITH PARTICULAR REFERENCE TO NUTRIENT UPTAKE BY PLANTS

(Publication No. 16,462)

Eliot Epstein, Ph.D.
Purdue University, 1956

Major Professor: Dr. H. Kohnke

A survey of the literature indicates that organic residues, when incorporated into the soil, reduce crop yield and nutrient uptake. One of the causes of low yields and low nutrient uptake by plants is poor soil aeration. It was reasoned that during the decomposition of incorporated organic residues, oxygen content decreases and carbon dioxide increases. The low oxygen and high carbon dioxide contents may become sufficiently great as to adversely affect plant development.

The effect of added organic matter on soil aeration has been studied. The experiment involved six phases:

A. Variation of Oxygen and Carbon Dioxide with Depth.

Little difference was found at 1, 3, and 8-inch depths for loose soils. Compact soils showed considerable variation at the three depths.

B. Location of Organic Matter.

Oxygen was found to be highest in the order: "check" > "surface mixed" > "two-inch layer" > "surface layer." A small difference was found in carbon dioxide between the treatments excluding the "check" treatment.

C. Effect of Moisture on Soil Aeration.

There was lower oxygen and high carbon dioxide content in compact wet soils. Compact soils showed a more pronounced effect.

D. Effect of Compaction on Aeration.

Differences in aeration between compact and loose soils were greater at low moisture contents than at higher moisture contents.

E. Effect of Different Types of Organic Matter.

Different types of organic matter influenced aeration. Alfalfa released more carbon dioxide than either straw or manure. Oxygen was lowest in the alfalfa treatment.

F. Effect of Different Soils on Aeration.

Soils of different textures affected aeration. Oxygen content was in the following order: sand > silt loam > silty clay loam. For carbon dioxide the order was: silt loam > sand > silty clay loam.

From the above results it has been shown that the addition of organic matter affects aeration. This effect may be sufficient to reduce plant growth and nutrient uptake. A preliminary greenhouse experiment was conducted to check this effect. Lower phosphorus uptake was found to occur in ten-day-old plants when organic matter was added to the soil. 166 pages. $2.08. Mic 56-1313

PHYSICAL AND CHEMICAL FACTORS INFLUENCING THE COLOR OF POTATO CHIPS

(Publication No. 15,840)

Ahmed Taha Habib, Ph.D.
The Ohio State University, 1955

The investigation included some of the physical and chemical factors influencing the color of potato chips. Four varieties of potato, namely, Katahdin, Russet Rural, Red Kote, and Red Pontiac—one of them, Katahdin, growing at high and low nitrogen fertility levels—were included in the study. Potatoes were stored at 40° F. for one month and then conditioned at 75° F. for another month. Samples were taken before and after cold storage and at the end of every week during conditioning for frying at three different temperatures, 350°F., 375° F. and 400° F. Alcoholic extracts were prepared and analyzed for total solids, reducing sugars, and free amino compounds contents. The sugars and free amino acids were separated and measured quantitatively by paper chromatography. The color of the chips was evaluated subjectively and measured objectively by the Hunter Color and Color Difference Meter. The pigments resulting from frying were extracted and measured spectrophotometrically at 390 mu wave length.

Hunter "L" readings showed a high correlation with both the subjective color ratings and the concentrations of the extracted pigments. The Hunter Color and Color Difference Meter is thus considered an accurate means of measuring the color of potato chips objectively. Specific gravity and total solids contents of raw potatoes gave low correlation coefficients with Hunter "L" readings. The coefficients were below the minimum used for prediction purposes. Moreover, varieties practically identical in these two characteristics produced chips distinctly different in color.

The contents of reducing sugar correlated highly with the color of the chips. However, varieties with essentially similar reducing sugar content produced chips significantly different in color. Reducing sugars alone could not thus be considered as criteria for suitability of potato varieties for chipping. Chromatographic tests indicated low values for the reducing/total sugars ratio associated with light-colored chips.

The relative quantities of free amino compounds were found to be the limiting factor in the color-producing reactions. Chromatographic analysis indicated that varieties with relatively high contents of free amino acids produce dark-colored chips. Furthermore, high values for the basic/total amino acids was found to be associated with dark-colored chips.

Storage at 40° F. resulted in accumulation of reducing sugars while it did not affect the free amino compounds significantly. Thus potatoes fried right after storage

produced unacceptable chips. Conditioning at 75° F., however, resulted in an increase in total solids and a decrease in reducing sugars and free amino compounds. High yields of chips and better color were obtained when potatoes were fried after three weeks of conditioning.

The nitrogen fertility level resulted in significant differences in the reducing sugars and free amino acids quantitatively and qualitatively. Katahdin tubers growing at a high nitrogen level produced chips of better color.

With any variety, frying at 375° F. resulted in lighter-colored chips than frying at 350° F., and this in turn was better than frying at 400° F.

217 pages. $2.71. Mic 56-1314

CARBON-PHOSPHORUS-NITROGEN RELATIONS DURING DECOMPOSITION OF PLANT RESIDUES

(Publication No. 15,489)

Arthur Edward Hiltbold Jr., Ph.D.
Cornell University, 1955

This study dealt with transformations of carbon, phosphorus, and nitrogen in decomposing plant materials. Assimilation and release of nutrients, particularly phosphorus and nitrogen, by a mixed microflora, were considered. Of particular interest was the relation of the energy status in decomposing residues, reflected in carbon changes, to direction and magnitude of phosphorus and nitrogen changes. Tracers were employed in estimating rate and degree of interchange between organic and inorganic forms.

Samples of plant materials were allowed to decompose in aerated flasks under constant temperature and humidity for periods ranging from one to eighty-one days. Sampling at each date consisted of extracting a set of residues and determining organic phosphate, mineral nitrogen, and cumulative carbon dioxide evolved. By tagging the initial inorganic phosphate content with radioactive phosphate, and the initial mineral nitrogen with heavy nitrogen, transformations of these elements were followed.

A vigorous microflora was elaborated within the first few days. During this period, evolution of carbon dioxide and assimilation of inorganic phosphate and mineral nitrogen were at their maxima. Subsequent changes in level of these inorganic constituents were related to the amount of residual available energy material. With depletion of readily utilized carbonaceous material, the original level of inorganic phosphate was restored. Little accumulation above this level occurred. No accumulation of mineral nitrogen was observed; instead, nitrogen in excess of microbial needs was volatilized.

Interpretation of tracer data led to the following conclusions:

1. Rapid interchange of phosphorus occurs between inorganic and organic forms during decomposition of plant materials. Microbial synthesis of fresh organic forms replaces original phosphorus residues of plant origin within the first week of decay. An appreciable amount of reworked phosphate from the first day's immobilization may reappear in inorganic form at the second day.

2. In residues containing adequate nitrogen and phosphorus for normal decomposition, the rates and extent of interchange of both nitrogen and phosphorus are greater than can be differentiated in this study, due to continual reworking of nutrients in microbial activity. There is a suggestion that nitrogen content is more likely to be a critical factor in decomposition than is phosphorus, and that in nitrogen deficient residues the rate nitrogen turnover may lag behind that of phosphorus.

145 pages. $1.81. Mic 56-1315

CHELATING ABILITY OF SOIL ORGANIC MATTER

(Publication No. 16,473)

Frank Lawrence Himes, Ph.D.
Purdue University, 1956

Major Professor: Dr. Stanley A. Barber

The soil organic matter reacted with divalent metal ions in a manner similar to chelation reactions. Radioactive zinc was used to determine the retention of divalent metal ions by the soil or soil fractions. After equilibrium of the zinc between the soil and solution, the supernatant liquid was analyzed for zinc. The equilibrium constant was determined from this data.

The influence of pH and ionic strength on the amount of zinc adsorbed by the soil was determined by multiple regression analysis. A prediction equation was obtained which showed that the amount of zinc adsorbed by the soil was related to pH and ionic strength. The amount of zinc adsorbed by the soil increased with an increase in pH, and decreased with an increase in ionic strength.

It was found that part of the zinc adsorbed by the soil could be replaced by potassium, and this was considered as zinc on the base exchange complex. Additional zinc could be replaced by copper; this was considered to be chelated zinc.

The evidence of the importance of the organic matter in chelation was found by comparing the release of silver from soil with organic matter to that from soil without organic matter. The release of silver from the soil without organic matter was complete within thirty minutes. The release of silver from the soil with organic matter, however, was not complete within one week. This indicated the importance of the soil organic matter in chelation type reactions.

The retention of zinc by the soil with hydrous silicates removed, was similar to that of the untreated soil. This was further evidence to show the importance of organic matter in the retention of certain cations by Maumee sandy soil. The organic matter was fractionated into the humic and fulvic fractions. The humic fraction was found to retain approximately 59 percent, and the fulvic fraction was found to retain approximately 12 percent of the total amount of zinc held by the soil. The retention of zinc by purified pine lignin was compared to that of the soil, and it was found to be similar. Methylation of soil with dimethyl sulfate was just as effective in decreasing the retention of zinc as methylation of the soil with diazomethane. The latter reacted with the carboxyl groups as well as with those blocked by dimethyl sulfate.

The rate of exchange of radioactive zinc in the soil with non-radioactive zinc in solution was rapid so that it was concluded that zinc was not held in a fused ring structure.

When a series of soluble chelating agents were added to the soil suspension before zinc, it was found that zinc-soil compound was more stable than the zinc-alanine compound. The zinc-soil compound was less stable than the zinc-nitrilotriacetic acid compound. The stability constants for zinc-alanine chelate and for zinc nitrilotriacetic acid chelate were reported as 5.2 and 10.4 respectively. The maximum amount of adsorption or the maximum amount of metal chelate that could be formed was calculated from adsorption data with the Langmuir equation. With this data, the equilibrium constant at pH 7 in 2 N KCl could be calculated, and hence, the stability constant. The calculated value for the stability constant was 5.6.

When the compounds, alanine, lactic acid, (ethylenedinitrilo) tetraacetic acid, and soil were added to zinc solutions, the order of availability of zinc to German millet was in the same order as their stability constants.

This investigation indicates that chelation type reactions which occur in the soil can influence the availability of micronutrients to the plant.

94 pages. $1.18. Mic 56-1316

THE IMPROVEMENT OF LODGING RESISTANCE IN KINDRED BARLEY BY USE OF THE BACKCROSS METHOD OF BREEDING

(Publication No. 16,178)

Martin Leo Kaufmann, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor H. L. Shands

The backcross method of breeding was used in an effort to combine the malting quality of Kindred with lodging resistance. Five varieties, the pedigrees for which were given, were used as donor parents for lodging resistance. Field and greenhouse facilities were used to permit 2 backcrosses each year. Emphasis was placed on straw stiffness of F_1 and related F_2 plants at flowering time in choosing F_1 parents for field backcrossing. Standing ability of the F_2 was the criterion for selecting F_1 and F_2 plants for progeny testing. F_1 (crossed) seed of plants in resistant rows was sown in the greenhouse for further backcrossing.

F_1 and F_2 seeds from the same greenhouse plant were planted in 4 and 12 foot sections of a continuous 16 foot root. Progeny of F_1 and F_2 field selected plants were grown in plots consisting of 2 four-foot rows, and F_3 and F_4 bulked lines in 3 row plots 10 feet long. Replicates were placed at different field locations for progeny and bulk line testing.

Morphological studies indicated that seedling root length and basal shoot diameter were not significantly correlated with field lodging reaction, and were not considered to be of use as a lodging index. Good coronal root development was associated with field lodging resistance, according to field and greenhouse root studies involving parental varieties and backcross lines. In the absence of lodging variation, it was suggested that coronal root development could be used as a lodging index but that caution be exercised.

Lodging resistance equal to that of the donor parents was maintained in selected lines through the third backcross. Some fourth and fifth backcross lines appeared superior to Kindred, but further testing was necessary to determine the value of these. A highly significant correlation was obtained between lodging ratings for 2 years.

Malting results for 2 years indicated that most of the selected lines of the second and third backcrosses were superior to the non-recurrent parents and that some approached the quality of Kindred. Fourth and fifth backcross lines showed promise for malting quality in 1955. Lodging resistance and high kernel weight were significantly correlated. The average yield of selected second and third backcross lines was higher than that of Kindred or non-recurrent parents. Yielding capacity was significantly correlated with lodging resistance in 1955 bulked progeny trials. Mildew resistance of 2 donor parents was carried through the third backcross in some lines.

Derivatives of 1 donor parent appeared to be superior in lodging resistance and derivatives of another were superior in malting quality, according to 2 years' results. It was recommended that more than 1 donor parent be used in a backcrossing program of this type.

According to the results, although inheritance of lodging resistance was not simple, resistance was maintained through 3 backcrosses under growing conditions at Madison, Wisconsin. It was postulated that, by continued backcrossing to lodging resistant lines, malting quality and lodging resistance could be combined, unless undesirable genetic linkages or physiological associations were present.

92 pages. $1.15. Mic 56-1317

VARIABILITY IN THE INFECTION OF WHEAT BY PUCCINIA GRAMINIS TRITICI AND STUDIES ON EXTRACTS FROM RUST UREDIOSPORES

(Publication No. 15,984)

Mary Ann Swaebly, Ph.D.
University of Minnesota, 1955

Adviser: Helen Hart

Puccinia graminis Pers. f. sp. tritici Erikss. and Henn. is an obligate parasite composed of many physiologic races and biotypes each with distinct and specific pathogenic capabilities. The study of rust resistance in cereals is concerned primarily with the assault by the fungus and with the defense reactions of the host, both of which may be influenced by external factors. This study deals with four aspects of rust resistance; 1) the parasitic capabilities of three biotypes of one race on a single host variety, 2) the influence of external factors on the development of two races of rust on one host variety, 3) the effect of an extract from germinating urediospores on wheat cells and on the germination of other urediospores, er and 4) the effects of germinating urediospores on the chloroplasts and cell walls of non-graminaceous hosts.

Three biotypes of race 15B have different inherent capacities for aggressiveness on Khapli emmer as judged by histological study of changes effected in the wheat cells and rust fungus during infection by each biotype. One biotype kills host cells rapidly and its development is very restricted. The second biotype establishes sufficient

nutritional relationships with the host to survive for a short time and to produce a few normal spores. The most aggressive biotype varies in its parasitic attack, but occasionally forms large uredia and sporulates well.

Kentana wheat varies in its reactions to races 11 and 15B according to the temperature under which the infection develops. High temperature (80-85°F.) favors the formation of large uredia, abundant mycelium and well developed haustoria while host cell damage is at a minimum. Conversely, at low temperature (65-70°F.) only small uredia are formed. Mycelial development and haustorial formation are limited, and host cell damage, including warting and swelling of the host cell walls, corrosion and depletion of the chloroplasts, is marked. At both temperatures some infection centers fail to develop beyond the appressorial stage, but even without fungus penetration the damage to the mesophyll cells is evident. This is interpreted as evidence of a diffusible toxin produced by the appressorium.

Kentana often is difficult to infect with certain races of stem rust. Urediospores may germinate well and produce appressoria on the leaf surfaces, but the rust may not enter the leaf. Further, urediospores on Kentana require a longer moist chamber period than do spores on Little Club, and the spores do not survive as well on the dry foliage of Kentana as they do on that of Little Club.

A substance toxic to cereal seedling leaves is produced by and can be extracted from germinating urediospores of races 11, 15B and 56. The substance, which is heat-labile, produces small flecks, leaf tip chlorosis and necrosis and host cell damage similar to that observed in wheat seedlings infected by uredial mycelium. Extracts from different races differ in the rapidity, amount and/or kind of injury produced on each host, and host varieties react differently to the extracts. Seedlings of some host varieties previously treated with the toxic substance from race 15B are more severely damaged by subsequent inoculation with the same biotype than by either extract treatment or inoculation alone.

Another substance, which was heat-stable and could be extracted from germinating or non-germinating urediospores, had a stimulatory effect on the germination of old urediospores. Germinating urediospores, however, did not have any visible effect on the chloroplasts and cell walls of non-cereal hosts.

106 pages. $1.33. Mic 56-1318

THE PHYSIOLOGICAL AGE OF BROMEGRASS (BROMUS INERMIS LEYSS.) AS IT AFFECTS GROWTH RATE FOLLOWING DEFOLIATION

(Publication No. 16,496)

Merle Russell Teel, Ph.D.
Purdue University, 1956

Major Professor: G. O. Mott

Smooth brome (Bromus inermis Leyss.), commonly called bromegrass, is a rhizomatous perennial forage grass well suited for use as hay and pasture in the northwestern corn belt region.

Desirable performance of bromegrass is highly dependent on proper management. A semi-dormant condition frequently occurs in midsummer regardless of added precautions taken in the fall and spring to insure vigorous growth.

A semi-dormant condition is induced in bromegrass by intensive defoliation of the tillers during what is suspected of being a phase of juvenility. This growth stage is characterized by the following attributes:

(1) rapid vegetative growth,
(2) low carbohydrate reserves in the storage tissue,
(3) internode elongation resulting in an elevated apical meristem,
(4) absence of growth of new tillers from adventitious rhizome buds.

Bromegrass has low tolerance to mowing or intensive grazing during this growth stage because the apical meristem may be destroyed prior to the advent of new tiller growth from adventitious rhizome buds.

It is postulated that tiller growth from rhizome buds is activated by the translocation of photosynthate from the leaves to the root system. During periods of rapid vegetative development photosynthate is presumably utilized as rapidly as it is produced by the leaves. As the tillers approach maturity, however, carbohydrates containing fructose accumulate in the basal internodes of the stem and in the rhizomes. The concurrent activation of new tillers is therefore interpreted to be related to carbohydrate metabolism. 107 pages. $1.34. Mic 56-1319

VARIETAL RESPONSE TO CLIMATE AND CULTURE AS RELATED TO THE DEVELOPMENT OF INTERNAL BROWNING IN POTATO TUBERS

(Publication No. 16,501)

Arthur Ripatte Wolcott, Ph.D.
Purdue University, 1956

Major Professor: N. K. Ellis

Twenty potato varieties and seedling lines were planted, using different cultural practices, on muck soils in northern Indiana. Variations in internal browning injury were correlated with variations in growth and tuberization phenomena that are known to be strongly influenced by photoperiod and temperature. Internal browning was found to develop under conditions of fluctuating vine and tuber growth that are known to give rise to resorption of stored materials from the tubers. Periods of rising temperature in August were associated with resurgent terminal vine growth, resorption of smaller tubers and initiation of necrotic symptoms in larger tubers. Cool temperatures in September prolonged life of vines, promoted regrowth and roughness in the tubers. Alternating periods of high temperature during the short days of September were conducive to severe internal browning. Extensive resorption of tubers during September in 1954 was associated with a sharp increase in browning over the previous year. Late planting, optimum moisture and excessive nitrogen promoted extension of growth into this particularly damaging period.

The early necrotic symptoms found during August were of the internal brown spot type, ranging from diffuse flecking to irregular blotches and large central lesions. Injury

observed as vines were turning color was of the corky ringspot type. After vines were dead, necrosis with scattered cavities was found, of a form recognized in Europe as canker type rust spot. The different types were found together in the same plots of most varieties, and even in the same hills. Sequential appearance during the season, and simultaneous occurrence in the same variety suggest strongly that these types are related in origin but differ in pattern as a result of the different physiological age of tuber tissues at the time that injury occurs.

173 pages. $2.16. Mic 56-1320

BACTERIOLOGY

THE REQUIREMENTS FOR PRODUCTION AND GERMINATION OF SPORES OF ANAEROBIC BACTERIA

(Publication No. 16,401)

Donald Oliver Hitzman, Ph.D.
University of Illinois, 1956

Spores of the anaerobe, Clostridium roseum, are stimulated to germinate by amino acids in a manner similar to what has been observed by a number of investigators with spores of aerobic bacilli. After 48 hours incubation at 37°C, nearly 100% sporulation is obtained with this anaerobe in a clear medium containing 1.5% Trypticase (a pancreatic digest of casein), .5% NaCl, .25% K_2HPO_4, and .2% dextrose. It was found that varying the ratio of dextrose to Trypticase decreased the spore crop within the 48 hour growth period with spore formation being directly influenced by the time, temperature, and method of incubation. Sporulation reaches a peak at the end of 48 hours (56 hours at 30°C) after which there is a gradual decline due to germination in the growth medium. To prevent germination in the growth medium it is cooled to 4°C and the spores harvested by centrifugation and washed with distilled water until free from absorbed nutrients. The appearance of these clean spores does not change and they remain viable for at least two years when suspended in distilled water.

Germination of these clean anaerobic spores was measured by the losses of heat resistance, change in optical density, and permeability to common bacteriological stains. Any material can be tested for the presence of germination factors by these methods if the conditions are anaerobic and the reaction is neutral. Trypticase and other digests, especially Thiotone (peptic digest of animal tissue), and fresh pork liver extract contained the greatest concentrations of the germination factors. These three materials were fractionated by various methods to isolate the active material and it was found that three amino acids, L alanine, L phenylalanine, and L arginine, would cause substantially complete germination in 15 minutes. When these three amino acids are added to a suspension of anaerobic spores in distilled water at pH 7 containing .05% sodium thioglycollate (for anaerobic conditions) germination takes place in from 2 to 5 minutes. Germination can be followed by observing the changes in light transmission with a spectrophotometer as these changes parallel the loss of heat resistance and stainability of the cells. The optimum concentrations of these three amino acids per cc of germination solution for rapid germination were found to be: L alanine 1.44 mg/cc, L phenylalanine .285 mg/cc, and L arginine .285 mg/cc, with any substitution of another amino acid for one of these three resulting in no germination. The D forms of these amino acids were inactive but did not inhibit germination. Decreased concentrations of L alanine resulted in a sharp decrease in germination while an increase in concentration also resulted in decreased germination. An increase or decrease in L arginine or L phenylalanine resulted in similar decreases although not as severe as with L alanine. Thus, the concentration of the three amino acids is as important as their presence. All three amino acids must be present at the same time for complete germination. The interaction of other amino acids on germination by these three is obscure as every combination would affect germination differently. The rate or extent of anaerobic spore germination was not affected by prior subleathal heating of the spores. It was found that germination of these anaerobic spores by Thiotone could be completely inhibited by any one of the following: 10% NaCl, 8% K_2HPO_4, 6% KNO_3, 6% $NaNO_3$, 6% K_2SO_4.

90 pages. $1.13. Mic 56-1321

GENETIC FUNCTIONS OF PROPHAGE: INTERFERENCE WITH THE MULTIPLICATION OF HETEROLOGOUS BACTERIOPHAGES

(Publication No. 15,236)

Seymour Samuel Lederberg, Ph.D.
University of Illinois, 1955

Bacterial strains E. coli B and K-12 and Sh. dysenteriae Sh are hosts for the bacteriophages T1-T7, P1 and P2. In P1-lysogenic derivatives of strains B, K-12 and Sh, the growth of phages T1, T3, T7 and P2 is suppressed. In P2-lysogenic derivatives of strains K-12 and Sh, but not of strain B, the growth of phages T2, T4, T5 and T6 is suppressed. These suppressions represent instances of "conversion" of bacterial properties by specific prophages, that is, by the latent form of bacterial viruses.

The interaction between T2 and Sh(P2) and between T1 and B(P1) was studied in detail.

Phage T2 adsorbs to bacteria Sh(P2). The infected cells neither grow, nor divide, nor lyse; respiration continues at a constant rate. The cell chromatin becomes dispersed. Artificial disruption does not reveal any infectious T2. About 1 in 10^4 infected cells of Sh(P2) liberate normal T2. The frequency of such yielder cells increases with the number of phage particles adsorbed and is dependent on the physiological condition of the cells prior to infection. Phage T2 excludes phage P2 from growth in mixed

infection of Sh. This shows that it is the P2 prophage itself that prevents T2 growth rather than the presence of some P2 material within the bacterium.

Phage T1 is adsorbed by B(P1); most infected cells do not produce phage T1, but survive. About 1 in 10^4 infected cells liberate phage T1. The frequency of yielder cells again increases with the amount of phage adsorbed. Some of the yielders produce normal T1; some produce both normal T1 and a modified form that can grow on cells B(P1) and Sh(P1) as well as on B or Sh. The modified T1 loses its modification after one cycle of growth in B.

In simultaneous mixed infection of B(P1) with T1 and modified T1, the normal phage succeeds in contributing genetic characters. Restricted phage does not inhibit multiplication of modified phage.

Certain bacterial mutations to streptomycin resistance interfere with the suppression of heterologous phages by prophages P1 and P2. This effect is not a change in the prophage itself. The ability to support growth of a phage and to produce modified phage can be present in various combinations in such mutant bacteria.

Ultraviolet irradiation of either bacteria or phage changes the frequency with which heterologous phage grows in lysogenic bacteria only to the same extent that it reduces phage growth in nonlysogenic cells.

78 pages. $1.00. Mic 56-1322

THE STUDY OF PRESUMPTIVE HETEROKARYONS IN ASPERGILLUS FONSECAEUS

(Publication No. 16,220)

Claude Eugène Vézina, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Kenneth B. Raper

By ultraviolet irradiation of Aspergillus fonsecaeus Thom and Raper, NRRL 67, Raper and Fennell (J. Elisha Mitchell Sci. Soc., 69, 1-29, 1953) induced and isolated eleven color and morphological mutants: Tan, Pink, Bronze, Orange, Honey, Fuzzy, Brown, Thin, Cinnamon, Clay and Buckthorn. They paired the parent and the mutants, examined forty-six of the sixty-six possible combinations, and found thirty heterokaryons: 19 black, 7 "blends" and 4 gray-brown heterokaryons. Three combinations, Brown + Tan, Pink, Bronze, yielded only "presumptive heterokaryons" which contained conidia of the Brown component only. Brown + Clay also formed presumptive, in addition to true, heterokaryons.

In the present study, all the possible combinations were examined for their ability to form heterokaryons. Seven new black heterokaryons were obtained in combinations not previously studied by Raper and Fennell; three black heterokaryons were found in the combinations Brown + Tan, Pink, Bronze reported by them to form only presumptive heterokaryons.

The observed heterokaryons fall into three groups corresponding to three degrees of complementation: blend-heterokaryons result from a dilution effect; gray-brown heterokaryons are the expression of incomplete complementation; black heterokaryons manifest complete complementation of the pigment-forming abilities of the mutants. The black pigment can also be restored outside heterokaryosis to produce presumptive heterokaryons.

The formation of presumptive heterokaryons depends on the variability of the mutants on high-sugar media: Brown + Clay produces large black heads when cultivated separately on these media. Tan, Pink and Bronze continue to produce their characteristic pigments on the same media. It is obvious that the presumptive heterokaryons in Brown + Clay contain only Brown or Clay nuclei according to their position in the colony; Clay spreads more easily than Brown and forms a pure colony outside the compact central area where Brown, Clay and the heterokaryon develop. The amount of sugar necessary for black pigmentation of Clay alone is higher than that which induces black pigmentation of Clay when paired with Brown. It thus seems that the metabolites of Brown add to its black pigmentation.

Brown + Tan, Pink, Bronze, Clay, on steep agar, also yield a large number of presumptive heterokaryons. The metabolites of Tan, Pink, Bronze may possibly induce their formation, but extracts prepared in this study were not effective. The alternative is that anastomosis takes place without the migration of nuclei (or in very limited numbers), and the complementation is effected in the cytoplasm which is carried to the point of pigment deposition, namely the conidia. The experimental evidence in favor of these two hypotheses is presented, but does not permit to choose one of them and to exclude the other.

The family of mutants of Aspergillus fonsecaeus appears to provide excellent material for the study of the various levels of interaction at which the pigment of the wild-type is produced, and for the study of the biosynthesis of the pigment. Cytological observations are necessary to clarify the populational interactions which gain expression via the presumptive heterokaryons.

152 pages. $1.90. Mic 56-1323

FACTORS INFLUENCING THE GROWTH OF NEWCASTLE DISEASE VIRUS IN TISSUE CULTURE

(Publication No. 16,225)

Fred Zuschek, Ph.D.
The University of Wisconsin, 1955

Supervisors: Professors C. A. Brandly and R. P. Hanson

The growth of Newcastle disease virus was studied in chorioallantoic membranes suspended in Tyrode's solution. The virus grew best if the pH of Tyrode's solution was between 7.0 and 9.5. Certain ions in the Tyrode's solution, such as potassium, were required for Newcastle disease virus growth while other ions, notably calcium and magnesium, at concentrations above those normally found in Tyrode's solution were detrimental to virus production in the chorioallantoic tissue. Calcium or potassium was not required for adsorption of the virus to the membranes.

The virus grew best in tissue cultures incubated at 42 C. Growth of Newcastle disease virus was limited to incubation temperatures between 33 and 42.2 C. The μ value for virus growth in tissue culture obtained at incubation between these temperature values was 12.33×10^3 calories. The production of hemagglutinin by Newcastle disease

virus in embryonating eggs followed a linear response to the incubation temperatures. Hemagglutinin production could not be demonstrated in tissue cultures in which NDV had grown to titers of 10^8 ELD_{50} per ml.

The growth of Newcastle disease virus in chorioallantoic membranes was stimulated by oxygen and inhibited by hydrogen. However, virus growth could be obtained under anaerobic conditions. The addition of glucose to the Tyrode's solution seemed to have an adverse effect on virus production under aerobic conditions but stimulated virus growth under anaerobic conditions.

Certain antimetabolites (2,4-dinitrophenol, proflavin and sodium azide) were very active in inhibiting the growth of Newcastle disease virus in tissue culture. Inhibition was probably by interference of energy transfer from high energy phosphate compounds of the host to be utilized for virus synthesis. The antimetabolites, at the concentrations used, were not virucidal for Newcastle disease virus and did not produce permanent damage to those cells of the membranes which have the capacity to support virus growth.

However, other antimetabolites as urethane, sodium malonate and sodium fluoroacetate were not effective in inhibiting the growth of Newcastle disease virus in tissue culture.

Glycolysis of normal noninfected chorioallantoic membranes suspended in Tyrode's solution was reduced by approximately 34 per cent by infection with Newcastle disease virus. Greater amounts of inorganic phosphorus were liberated into Tyrode's solution in which virus-infected tissue was suspended than in that which contained noninfected tissue. Lesser change in the pH of Tyrode's solution was produced by infected tissue than by noninfected membranes. The optical density, measured at 410 mμ, of Tyrode's solution which contained virus infected tissue increased at a more rapid rate than that containing noninfected tissue.

Growth patterns in tissue culture and growth rates at different temperature of incubation of three different strains of Newcastle disease virus (GB, B_1 and Roakin) did not differ from one another.

183 pages. $2.29. Mic 56-1324

BIOLOGY

BIOLOGY, GENETICS

GENETIC STUDIES OF THE ANTIGENS OF THE ERYTHROCYTES IN THE CHICKEN AND THEIR ASSOCIATION WITH PHYSIOLOGICAL CHARACTERISTICS

(Publication No. 16,149)

Connally Oran Briles, Ph.D.
The University of Wisconsin, 1955

Supervisors: Professors Malcom R. Irwin and William H. McGibbon

Reagents specific for 15 different antigenic substances of the red blood cells of the chicken (Gallus gallus) were prepared by differential agglutinin-absorption of isoimmune sera resulting from transfusion of erythrocytes between chickens. These reagents were employed in testing the agglutination of the red cells of birds of known parentage. Data concerning the inheritance of each of the antigenic substances detected by the respective reagents were obtained from the progeny of matings of birds found to be heterozygous for the genes for two or more antigenic substances to individuals whose cells lacked these same substances. Each unit antigenic substance segregated in the offspring from these matings as expected if each were the product of a single gene. These substances belong to five genetic systems of cellular antigens -- A, B, C, D and E.

The antigen distribution in the progeny of these testcrosses also provided information on the relationships of the causative genes. For example, five reagents were found to interact with cellular antigens of the A system produced by genes at the A locus; these reagents contained antibodies for the A6, A7, A8, A9 and A68 antigens, respectively.

Nine alleles were recognized at the A locus, corresponding to the respective antigens of the A system: A6, A7, A8, A9, A68, A78, A79, A689 and a. The lower case letter in each genetic system of antigens, as "a" in the A system, indicates the presence of an allele for which no antigenic effect has been detected. Each digit represents an antigenic specificity of the antigenic substance, and this specificity is detected by the ability of the cells to react with a specific reagent. Various antigenic substances as A7 and A8, A7 and A9, were antithetical to each other, as expected of the products of alleles. Further, antigenic specificities A7 and A8, and A7 and A9, were observed in the progeny of some individuals to behave in inheritance as a unit, presumably the product of a single gene. This recognition of two or more specificities of a unit substance is another example of multiple antigenic specificities of the product of a single gene.

Four alleles were recognized at the B locus: B2, B8, B28 and b. Two alleles were recognized at each of the C and D loci: C12 and c, D1 and d, respectively. Six alleles were recognized at the E locus: E1, E2, E12, E4, E24 and e. There is suggestive evidence that the A and E loci are linked, since only two classes of testcross progeny occurred in some families when a 1:1:1:1 ratio was expected.

The cells of members of two inbred lines of Single Comb White Leghorns, characterized by either small or large egg size, were tested with the reagents detecting antigens of the A, B, D and E systems. An analysis of variance for possible association between egg size and cellular antigens revealed no association between egg size and the A7, A9, B28, D1 and E1 substances.

Possible correlations between greater body weight of

New Hampshire chicks at 6 weeks of age and presence or absence of 8 antigens (A6, B2, B268, M24, M34, O3, P4 and S2) were sought. The reagents for B268, M24, M34, O3, P4 and S2 were not prepared by the author. The body weights of both male and female chicks whose cells were reactive and non-reactive with the A6, B2, B268, M34, P4 and S2 reagents gave non-significant differences. There was a significantly greater body weight of males whose cells did not possess the M24 antigen as compared to the body weight of males whose cells contained the M24 antigen, but this association may have been due to chance, since no such association was found in the females. However, the significantly greater body weights of both males and females whose cells possessed the O3 (B6 of the B system) antigen than those without it are indicative of a definite association. This association further substantiates previous findings of a correlation between greater body weight and the effects of genes at the B locus reported by Briles.

79 pages. $1.00. Mic 56-1325

BREEDING IN TALL FESCUE FOR PALATABILITY

(Publication No. 15,919)

Robert Cecil Buckner, Ph.D.
University of Minnesota, 1955

Adviser: W. M. Myers

Tall fescue (Festuca arundinacea, Schreb) is a pasture grass that has several characteristics of a valuable pasture crop; however, it is considered to be relatively low in palatability as compared to most other pasture grasses. Therefore, a study was initiated at the Kentucky Agricultural Experiment Station in 1950 to determine differences in palatability between varieties and plants by using grazing animals.

Varieties established in sod plots were grazed with dairy cattle. Although no differences were shown during the first year, the G1-43 variety was preferentially grazed at each of several grazing periods during the second and third year after establishment.

A source nursery consisting of 2750 two-year-old spaced plants was repeatedly grazed during 1950. Although animal selections varied considerably with the season, some plants were consistently well grazed at all grazing periods. Additional studies in a replicated clonal nursery on plants well grazed in the source nursery showed that plants selected from source nurseries should have additional testing before being permitted to produce progeny.

Two breeding studies conducted simultaneously to compare the feasibility of improving tall fescue for palatability consisted of allowing only best grazed plants to produce cross-pollinated seed and of saving self-pollinated seed from best grazed plants to establish the succeeding generation. Three generations of selection were studied. Although lines were found to differ somewhat in the first and second generation nurseries the first year after establishment, greater differences were obtained between lines in the second year of test, which suggested that age of plants influenced palatability. Third generation material was grazed in the spring and early summer the first year after establishment. Lack of significant differences between lines in the third generation may have been due to immaturity of the material, although variability may have been restricted due to continued selection so that lines did not differ significantly for palatability.

Differences in palatability between grazing dates were highly significant in both the first and second generation nurseries. Certain lines well grazed at one grazing date were well grazed at other grazing dates.

Characters studied by covariance analysis and found to show association were the degree of grazing of inbred and open-pollinated lines in the first generation nursery and the degree of grazing of parent plants and second generation progenies.

Vigor ratings made on plants before each grazing period showed that inbred lines were reduced 35 per cent in vigor in the first generation and approximately 50 per cent in the second and third generation as compared to open-pollinated lines. Correlation between vigor and palatability was found to be low and non-significant in every case.

Several third generation inbred lines and the Ky. 31 variety were analyzed for carotene content. No relationship was found between palatability of plants and carotene content.

Third generation inbred lines analyzed for crude protein, fat, fiber, moisture, ash, and nitrogen-free extract were found to differ significantly for protein, fat, fiber, and nitrogen-free extract. There seemed to be some relationship between low fiber, high moisture content, and palatability. Certain well grazed lines were also high in protein. Thus, the possibility is suggested of developing synthetics that are not only more palatable but also more nutritious. Then, if greater palatability of the variety means greater consumption, the variety, if more nutritious, should produce greater animal gains than commercial varieties now in use.

Results of grazings on second and third generation inbred and open-pollinated material indicated that although progress was made by maternal-line selection, greater progress was made by the inbred-line method of breeding for palatability. 91 pages. $1.14. Mic 56-1326

HAY MOLDS AND THE FUNGITOXICITY OF 2,4,6-TRICHLOROPHENOL

(Publication No. 15,584)

Raymond Adolph Cappellini, Ph.D.
Cornell University, 1955

In many geographic areas, cut hays are stored with relatively high moisture contents, functionally related to particularly high relative humidities. A practical consequence has been the deterioration of these hays by various organisms, chiefly fungi. Recently, chemicals, among which is 2,4,6-trichlorophenol (TCP), have shown promising results under laboratory conditions for controlling growth of these "hay-molds." Isolation studies showed that twenty fungus species in the genera Aspergillus, Penicillium, Alternaria, Cladosporium, Rhizopus and Scopulariopsis were common on samples of alfalfa, birdsfoot trefoil, brome, red clover, timothy, timothy-clover, timothy-clover-alfalfa hays stored for 15 months at 20° C. and relative humidities varying from 72-95 per cent.

Molds did not develop on hay samples stored at 66 per cent relative humidity, but when these samples were placed at 95 per cent relative humidity, fungi similar to those on samples originally stored at the higher humidities were observed after one week. In spore-germination experiments, spores of Penicillium cyclopium, P. stoloniferum, Aspergillus niger, A. ochraceous, A. repens, A. sydowi, A. versicolor, Cladosporium herbarum, Rhizopus nigricans and Alternaria tenuis required from 3.9-116 and 88.5-250 ppm TCP for approximately 0-100 per cent inhibition, respectively, of germination. Dosage-response was linear with all species except A. tenuis which produced a smooth, concave ("J" type) dosage-response curve. Slopes of the linear dosage-response curves ranged from 1.8-17.9. Quantitative chemical analysis showed that spores of Penicillium cyclopium, Aspergillus niger, A. ochraceous, A. versicolor, Cladosporium herbarum and Rhizopus nigricans removed from 15,900 to 156,800 ppm TCP, on a spore weight basis, from solutions in which 50 per cent inhibition of spore germination occurred. Externally the concentration of the solutions ranged from 20-150 ppm TCP. The removal of such large amounts, representing from 1.6-15.7 per cent of the fresh weight of the hay-mold spores, indicates the relatively low toxicity of TCP against hay-molds. Manometric studies on the endogenous respiration of spores of Penicillium cyclopium, Aspergillus niger, A. ochraceous, A. versicolor, Alternaria tenuis, Cladosporium herbarum and Rhizopus nigricans incubated with various concentrations of TCP showed that at low concentrations (10^{-4}-5 x 10^{-4}M) respiration was stimulated from 168-563 per cent over the controls while at higher concentrations (10^{-3}-2.5x10^{-3} M) respiration was inhibited. This phenomenon suggests that oxidative phosphorylation is being inhibited in these species. Experiments with P. cyclopium spores incubated with TCP at high concentrations (1.25x10^{-3} M) showed that approximately 50 per cent inhibition of catalase activity occurs. 55 pages. $1.00. Mic 56-1327

INHERITANCE OF RESISTANCE TO PUCCINIA ASPARAGI DC. IN ASPARAGUS OFFICINALIS L.

(Publication No. 16,400)

Paul Raymond Hepler, Ph.D.
University of Illinois, 1956

Extensive tests on seedling and three month old plants of Asparagus officinalis L. did not locate immunity or atypical pustule development following artificial inoculation with urediospores of Puccinia asparagi DC. A major difference was obtained between the highly susceptible and "resistant" varieties. Varieties exhibiting high susceptibility were Mammoth Emperor, Snowhead, Conover's Colossal, and Eden. The resistant varieties were Mary Washington, Martha Washington, Waltham Washington, Seneca Washington, Argenteuil, Palmetto, Paradise, California 500, Viking and Raritan. Highly significant variability was found among strains of the resistant varieties. However, differences among the varieties were not consistently separable.

Crosses among plants selected for resistance (R) and susceptibility (S) exhibited continuous variation with the R X S crosses intermediate between the R X R and S X S crosses. Differences among R X R crosses were not attributable to specific resistant varieties. Sib matings and backcrosses were made among plants selected for resistance within nine selected R X R crosses and for susceptibility within two selected S X S crosses. The seedling spears of the second generation were tested approximately one week after emergence. Differences among the nine resistant families were pronounced while differences among crosses within families were small. The average intra-family heritability was about 18 percent. Multiple covariance procedures involving correlated seedling measurements did not increase the precision of the measurement of infection. Selection for resistance and susceptibility based on individual plant performance within the first generation crosses was ineffectual. One generation of sib mating reduced the height of the seedling spear about 10 percent.

Genetic populations were obtained by crossing plants of three related crosses, R X R, R X S, S X S, in all possible combinations. The population means did not deviate from a model based on additive gene action after the observations were transformed to the square root scale. The difference between the resistant and highly susceptible populations was determined by at least four or five genes. At least one of the genes for susceptibility was shown to be linked with a dominant gene inhibiting anthocyanin development. Heritability estimates of not more than 20 percent were obtained. These estimates were based on the genetic variance of the individual observations as well as on the variability of crosses within the genetic populations. The plants in this experiment were selected for a uniform stage of spear development and inoculated under controlled conditions. It would be expected, therefore, that selection of plants under uncontrolled conditions, as in the field, would not be effectual.

The third or fourth spear of plants 10 to 12 weeks old inoculated at the 50 percent needle (cladophyll) stage proved to be the most adequate method for evaluating resistance provided that only the primary pustules on the spear axis are counted. The growth of infected spears was retarded by the parasite during its incubation. Growth of spears following the infected spear was about twice as great from lightly as from heavily infected plants.
76 pages. $1.00. Mic 56-1328

THE EFFECT OF THE MORPHOLOGY AND PHYSIOLOGY OF THE CORN PLANT ON THE SURVIVAL AND CONTROL OF THE EUROPEAN CORN BORER

(Publication No. 16,410)

William Henry Luckmann, Ph.D.
University of Illinois, 1956

The growth and development of the corn tassel and the shedding of pollen appear to be the most important functions of the corn plant relative to survival of the European corn borer, Pyrausta nubilalis (Hubn.). Observations on newly hatched corn borer larvae indicate they do not survive when placed on young or small corn plants. The growth of corn borer larvae confined on small corn plants appears to be retarded and the small corn plant appears to

be nutritionally unfavorable for European corn borer larvae. The observed wanderlust tendencies of young larvae on small corn plants may also indicate that newly hatched corn borer larvae are capable of detecting a nutritional deficiency or objectionable characteristic in small corn plants. However, when small corn plants are dusted with pollen obtained from more mature plants, European corn borer larvae are able to survive on the small pollen covered plants.

Significant survival of the European corn borer on the corn plant begins at tassel ratio 15-20 and, except for a slight decrease in per cent survival at time of tassel emergence, survival increases until harvest of the plant.

The tassel ratio method of indexing the maturity of the corn plant was thoroughly studied and found reliable on representative varieties of field and sweet corn grown in Illinois. The tassel ratio index is widely used in Illinois and appears valuable for timing applications of insecticide for control of the first generation European corn borer.

Data obtained in 1955, on the egg-laying characteristics of the second generation European corn borer moth show that the borer moth prefers to lay eggs on corn in silking stages of growth. Late-whorl and early-green-tassel stages of corn growth appear least attractive to the second generation moth, although some egg deposition occurs on corn in these stages of growth.

56 pages. $1.00. Mic 56-1329

SOME EFFECTS OF SEA WATER AND TEMPERATURE ON THE EMBRYOS OF THE PACIFIC SALMON, ONCORHYNCHUS GORBUSCHA (WALBAUM) AND ONCORHYNCHUS KETA (WALBAUM)

(Publication No. 16,540)

Julius Rockwell, Jr., Ph.D.
University of Washington, 1956

Pink and chum salmon were shown to spawn naturally and successfully in the intertidal zone of the streams of Southeastern Alaska. Large collections of eggs in advanced stages of development were made from deep in the gravel where salt water was found to be present every high tide. Survival was found to be better in some intertidal levels than in those upstream.

To determine the effect of sea water on the eggs and larvae, laboratory experiments were conducted in which other variables were either controlled or closely observed. Each stage was separately studied, including fertilization, early and late eggs, hatching and larvae, using sea water salinities 0, 6, 12, 18, 24, and 30 ^{o}/oo.

It was shown that sea water salinity 18 ^{o}/oo and below does not inhibit fertilization and at salinity 30 ^{o}/oo some fertilization could take place. Percentage fertilization at an isotonic concentration, salinity 12 ^{o}/oo, was insignificantly superior to that in fresh water.

The resistance of eggs and larvae to sea water varied considerably between individuals. All survived several days before succumbing to even the highest concentration (30 ^{o}/oo). The concentration-time curves of 50 percent mortality were rectangular hyperbolae of the family $T = A(S-C)^{-B}$ where T = time, S = sea water salinity and where A, B, and C are constants. C is the concentration a given percent of the individuals survives indefinitely, and is definitely above zero. The value of C is considerably greater at lower temperatures than at higher ones for both eggs and larvae. However in the temperature range used (38^{o} F. - 50^{o} F.) larvae withstood higher concentrations then did eggs. Thus the highest tolerable condition needs be described by four coordinates: concentration, time, temperature, and percent mortality.

Below concentration, C, survival was apparently superior to that in tap water ($\overline{C}$a 7 mg/kg) for eggs at low temperatures. Larvae in mild sea water exhibited definitely superior growth, survival, and activity, which were probably due to the salts in the sea water.

Also included is a complete review of available information on the intertidal spawning of salmon, analyses of allied work, a critical review of the principle of thermal summations as applied to fish eggs, and a description of a modification of the probit method to describe the four dimensional picture of the limit of tolerance.

The form of the concentration-time curve plus observations of the dessication of larvae in high concentrations indicate that death is due to water withdrawal, a process which can be reversed (if it has not gone too far) by a return to a more dilute environment. It may be concluded that sea water in the upper and middle intertidal zone does not appreciably contribute to the mortality of the eggs and larvae (immersed in it for short periods of time).

488 pages. $6.10. Mic 56-1330

BOTANY

ECOLOGICAL ASSOCIATION TYPES IN THE ITALY HILL (N.Y.) SWAMP AREA

(Publication No. 15,586)

Jesse Franklin Clovis, Ph.D.
Cornell University, 1955

The purpose of this study was to determine the vascular and algal vegetation types of the area, and the ecological factors producing the types. The area is a virgin swamp forest in central New York, essentially unmolested by man. This condition is becoming quite rare in New York, and it is believed that a record of the vegetation and ecology of the area is a definite contribution to the knowledge of the vegetation of the state.

The area is a part of the Susquehanna River drainage system. It was glaciated during the Wisconsin glaciation, which is believed to have formed the major features of the area. The swamp proper is at the bottom of a wide saucer-shaped depression, which is the initiation point of a valley

in a rolling plateau 1500 feet above sea level. The surrounding slopes are gentle, the maximum range of elevation being about 255 feet. The total area is 3.32 square miles.

The Italy Hill area consists of the densely wooded swamp, Five Mile Creek, and the surrounding hillsides. Five Mile Creek drains the swamp, and forms a sluggish lake-swamp about one mile downstream. Below this point, the creek is narrower and maintains a faster current.

The vegetational analysis was made by consecutive visits to the area. Representative plants were collected from each of the vegetational areas, and ecological and floristic data were recorded at the same time. Miniature floras (plant lists) were taken at many sites, and these when organized produced an estimate of the relative frequency and habitat preference of the various species. These lists were a substitute for a random quadrat system of analysis, which the uneven distribution of the vegetational units made infeasible.

Field observations as to ecological associations were supported by an analysis of the above material. Eight association types were recognized: aquatic plants, alder thickets, alluvial plants, swamp forest, mesophytic woods, ravine plants, and xerophytic areas. These were distinguished on the basis of the vegetation being a direct resultant of all ecological factors present. In each type, the dominant factors are mentioned, and the major plant species indicative of each type are listed.

The swamp forest is the largest uniform type on the area, being about one mile long by one-half mile wide. The species present are characteristic of the Hemlock-Yellow Birch-Red Maple swamp forest type in the Hemlock-White Pine-Northern Hardwoods forest region. The soil here is a mucktype soil which is inundated the first half of the summer, and retains much of this moisture the remainder of the growing season.

This type presents an interesting example of "reverse succession," wherein the climax (for the area) is at the center of the swamp, with the shrubby and aquatic stages (normally previous to the climax) at its edges. This phenomenon is brought about by the clearing of wet meadows which revert to the marsh-meadow or shrubby successional stage.

The mesophytic woods type is the second largest type on the area, and is made up of many small units. The climax belongs in the Great Lakes Beech-Maple type, which in the northeast is a common alternate with the more northern coniferous communities.

In addition to the above work on vascular plants, 89 algal collections were made. The ecological factors present in each habitat were recorded, and in many cases it is shown that these factors are correlated with the algal taxa present.

An annotated catalog of 540 vascular plants, and one of 97 algal plants, show the respective floras of the area.

176 pages. $2.20. Mic 56-1331

A STUDY OF THE RESISTANCE OF CORN TO THE EUROPEAN CORN BORER

(Publication No. 16,188)

Robert Simpson Loomis, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor J. F. Stauffer

Literature pertaining to the mechanism of corn borer resistance is reviewed and it is shown that a portion of the resistance displayed by corn (Zea mays L.) to the European corn borer (Pyrausta nubilalis, Hubn.) is apparently due to the presence of toxic substances within the corn plant. The work reported in this thesis was undertaken in an attempt to isolate and identify such substances and to study their distribution within the developing corn plant. Methods are presented for the preparation and fractionation of aqueous extracts of corn plants and the quantitative bioassay (utilizing Penicillium chrysogenum) of the toxic substances which such extracts contain. Several corn borer inhibitory substances were detected in aqueous extracts and one of them was isolated in crystalline form and partially characterized. The distribution of this factor within developing corn plants is reported and it is shown that the concentration of the factor found in young plants is sufficient in synthetic diets to inhibit completely the growth of corn borer larvae. The partial isolation of the other factors detected and the possible role of all such toxic substances in the resistance of corn to the corn borer are discussed. 105 pages. $1.31. Mic 56-1332

THE STRUCTURE OF THE MAIZE CHLOROPLASTS

(Publication No. 15,283)

Albert Ernst Vatter, Jr., Ph.D.
University of Illinois, 1955

The structure of the bundle sheath and mesophyll chloroplasts was determined by electron microscopy. The bundle sheath plastids are surrounded by a thin membrane, 120-150 A thick, and the matrix of the plastid is traversed by thin lamellae, the intrachloroplastic lamellae, which anastomose to form "chambers". These "chambers" may contain starch grains and/or vacuoles. The mesophyll chloroplasts are traversed by similar lamellae which are modified in places to form grana.

Proplastids were identified in the undifferentiated cells of post-meristematic regions and the stages of metamorphosis of the proplastids into mature chloroplasts is reported. Dense, spherical to ellipsoidal bodies, plastomeres, are found in the apparently homogeneous stroma of the young proplastid. Plastomeres are present in the proplastids of both etiolated and green plants and occur singly or in groups of up to several hundred. The plastomeres undergo a transformation to give rise to a three-dimensional lattice-like structure which occupies a large portion of the proplastid.

Up to the formation of the lattice-like structure the stages of development are the same for both the mesophyll and bundle sheath plastids.

In the mesophyll plastid, lamellar extensions, which

radiate from the lattice-like structure, are modified by becoming thickened and denser in certain regions. At first no differentiation of the lamellae is recognizable, but within a short time laminations develop by the apparent division of thickened regions. The development of these structures, granal units, requires light. The granal units of adjacent lamellae coalesce to form grana.

Subsequent to the formation of the lattice-like structure in the bundle sheath plastids, lamellae perpendicular to the long axis of the plastid attenuate, but the lamellae parallel to the long axis of the plastid become denser and increase in length. As the age of the plastid increases, the "chambered" nature of the mature plastid becomes more evident due to the apparent anastomoses of the lamellae; frequently thickened bodies, incipient grana, develop at points of anastomoses.

The occurrence of starch in both the bundle sheath and mesophyll chloroplasts is discussed.

The occurrence and development of the proplastids and plastids in various chlorophyll mutants is described. Plastid development was found to be abnormal in all of the mutants. In the two lethal mutants, albino and luteus, development was more abnormal than in the two viable mutant types. The strains of Zea mays used in the present investigation were: (1.) Albino, Rhoades 17463 Wd/wd x 17462-9 wd/wd (ring), (2.) Luteus-10, Coop. 54-1044-6 Y 1_{10}/ 1_{10}(X), (3.) Virescent-2, Rhoades 17273 (X), (4.) Yellow green-2, Rhoades 15890 sib. yg_2 x yg_2, (5.) Inbred line Kys. Pigment content of the chloroplasts can be correlated with the morphology of the plastid.

132 pages. $1.65. Mic 56-1333

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

CHEMISTRY, BIOLOGICAL

THE EFFECT OF SUBSTRATE COMPETITION AND ANTERIOR PITUITARY GROWTH HORMONE ON FATTY ACID AND GLUCOSE UTILIZATION BY RAT TISSUES

(Publication No. 16,309)

Arthur Allen, Ph.D.
Temple University, 1956

Although detailed reaction pathways are now known for the catabolism of fatty acids and glucose in animal cells, relatively little information is available concerning the factors which regulate the utilization of these substances by individual tissues.

Up to recent years this problem was not recognized generally, owing to the prevailing belief that fatty acid catabolism was a prerogative of the liver cell and that extrahepatic tissues were exclusively or principally utilizers of carbohydrate, being presumably devoid of the enzymes for fatty acid catabolism. This problem is now brought to the forefront, however, as a result of the general recognition that hepatic as well as non-hepatic cells can carry out the oxidation of glucose and other sugars and that non-hepatic tissues, including even brain, can oxidize fatty acids.

It is logical to assume that organs having a multiplicity of substrates available from the arterial blood are equipped with means of choosing for catabolism those which are most suitable to their needs; as yet, however, nothing is known of the identity of such control factors, or the extent of their operation in individual tissues. Some of the hormones may function in this capacity, but there is as yet, however, no certainty about the biochemical site of action of any hormone. As a first approach to the study of the mechanisms regulating substrate utilization, experiments were conducted to determine the extent of fatty acid and glucose oxidation in individual tissues as well as in the intact animal when both substrates are simultaneously available for oxidation. In addition, similar studies were conducted to determine the effect of the growth hormone on fatty acid oxidation and synthesis, including also, some studies on glucose oxidation. All of these experiments were conducted with the aid of C-14 labeled compounds which makes possible a reliable measurement of the rates of substrate oxidation and synthesis, not dependent on differences from endogenous metabolism.

It was concluded from these studies done both in vitro and in vivo, that neither substrate competition between fatty acids and glucose for available oxygen, nor the presence of the growth hormone has any marked effect on the extent that either substrate is utilized by rat tissues.

The complete absence of substrate competition was observed during the simultaneous oxidation of glucose and exogenous long and short chain fatty acids in slices and homogenates of several tissues. Similarly, the addition of glucose to various tissue homogenates did not produce any marked lowering in the oxidation rate of endogenously labeled lipides, and studies in vivo demonstrated that the feeding of glucose to a fasting rat did not have any decided influence on the oxidation of fatty acids equilibrated with the tissue lipides.

The growth hormone did not accelerate the conversion of fatty acids or glucose to carbon dioxide or to acetoacetate in tissue slices and homogenates; this was true whether the hormone was added in vitro or injected prior to sacrifice of the animals.

Liver slices from rats injected with growth hormone a few hours prior to sacrifice exhibited a somewhat lower incorporation of C-14 labeled acetate into fatty acids and an increased incorporation into cholesterol. These effects, however, were neither marked nor consistent, and were completely absent when glucose was used as substrate.

Studies in vivo demonstrated similarly that injection of the growth hormone did not materially influence fatty acid or glucose oxidation by the rat.

High levels of growth hormone in vitro produced a generalized inhibition of tissue respiration. This inhibition was not believed to have physiological significance since it was obtained also with boiled and dialyzed preparations of the hormone. 123 pages. $1.54. Mic 56-1334

THE LIBERATION OF VITAMINS FROM CASEIN

(Publication No. 16,451)

Bernard Jay Brandwein, Ph.D.
Purdue University, 1956

Major Professor: S. M. Hauge

Fundamental research in animal nutrition has been handicapped by the lack of adequately purified proteins in experimental diets. All other components of such experimental diets have been purified of growth factors.

The protein most used for experimental diets is casein because of the ease of isolation and the essential amino acid content. All commercial caseins, including the so-called "vitamin-free" caseins, contain all the known B-vitamins and many uncharacterized growth factors as well.

The usual methods of purification involved repeated dispersion and precipitation of the protein at the isoelectric point, washing with dilute acid, and continuous extraction with hot alcohol. These methods, while serving to substantially lower the B-vitamin content, leave measurable amounts of the vitamins in the protein. More drastic treatments, such as enzymatic digestion or excessive washing with acids or bases, will release or destroy most of the B-vitamins in casein. Unfortunately, the products resulting from such treatments are usually drastically altered in physical properties and amino acid content.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

Consequently, a new method for the purification of casein has been developed. The method consists of a five-step commercially feasible process.

1. Crude casein is dispersed in water by adjusting the pH to 2.0 with phosphoric acid. The mixture is stirred at room temperature for sixteen hours. The protein is precipitated at the isoelectric point by the addition of sodium hydroxide, and washed with water.
2. The protein is dispersed in water by adjusting the pH to 6.5 with sodium hydroxide and then to 8.5 with saturated trisodium phosphate. Thymol and toluene are added to prevent bacterial action and the mixture is stirred for sixteen hours. The protein is precipitated at the isoelectric point with phosphoric acid and washed with water.
3. The protein is dispersed in water by adding phosphoric acid to a pH of 2.2-2.3. The mixture is stirred for sixteen hours. The protein is precipitated at the isoelectric point with sodium hydroxide and washed with water.
4. Step 3 is repeated.
5. The protein is filtered, placed in cotton bags, and extracted continuously with hot alcohol for seven days and ether for three days. The protein is then dehydrated with alcohol, acetone, and ether, air-dried for several days, and ground to a powder.

Thiamine, riboflavin, pyridoxine, and niacin have been completely removed, as determined by microbiological assays. Folic acid, pantothenic acid, and vitamin B_{12} were lowered to less than three percent of their original values in crude casein, and these three vitamins were completely removed by two or three additional dispersions at a pH of 2.2-2.3. The biotin level was lowered to that found in commercial "vitamin-free" casein. This remaining biotin is probably present as the biocytin complex, which would necessitate enzymic action for its removal.

The effectiveness of this purification process was also verified by growth tests with weanling rats. It was found that the characteristic vitamin deficiency symptoms appeared earlier in rats fed diets containing the purified casein than those fed diets containing commercial "vitamin-free" casein.

Microbiological assays have shown that certain uncharacterized growth factors such as vitamin B_{13} and orotic acid were also removed by the treatment.

53 pages. $1.00. Mic 56-1335

A PROBABLE CELLULAR SITE OF ACTION OF CIRCULIN

(Publication No. 16,457)

Dominic James Colasito, Ph.D.
Purdue University, 1956

Major Professors: Henry Koffler and P. A. Tetrault

Circulin, a polymyxin-type antibiotic, was shown to cause the release of soluble cellular constituents from washed cells of Escherichia coli ATCC 26. The detection of this release by either of two methods, 1) measurement of the increase in the supernatant liquid of materials which absorb energy having a wavelength of 260 millimicrons, and 2) determination of the release of radioactive phosphorus from cells labeled by growth on a medium containing P^{32} was used as a basis for the assay of the antibiotic. The range of the assay was from one to forty-five micrograms of circulin per ml when cell densities of 10^7 organisms per ml were employed. However, it was possible to shorten or extend the useful range through appropriate manipulations of the cell densities. For example, with 10^{10} organisms per ml as inoculum the range was extended to limits of from one to one hundred micrograms per ml. The recovery of added known amounts of circulin at high and low levels in two types of fermented media, both simple and complex in their composition, was from 90 to 110 per cent.

Adsorption of circulin by large cell concentrations of E. coli ATCC 26, Pseudomonas fluorescens P, Bacillus megaterium KM, Proteus vulgaris SBH, and a resistant isolate, E. coli R after two hours contact with the antibiotic was determined. In these experiments, a volume of water was added from the outside equal to that of the intracellular water. The results indicated that circulin was adsorbed specifically by the cells until saturation of some receptor sites had occurred, and that this was followed by a free diffusion of circulin into the cells. Complete saturation of the specific adsorption sites of the sensitive organisms was not necessary to kill the organisms. One-fifteenth of the amount specifically adsorbed is sufficient to cause 99.9 per cent killing of E. coli ATCC 26 and Pseudomonas fluorescens P.

Exposure of cells of Bacillus megaterium KM for a period of three and one-half hours to C^{14}-labeled circulin prepared by biosynthesis, followed by fractionation of the cells by means of a controlled lysozyme treatment pointed toward an external site of action for the antibiotic. At concentrations which caused 99.9 per cent killing of the organisms, no circulin was detected in the cytoplasmic fraction. Further, it was shown that circulin did not enter the cytoplasmic fraction upon prolonged incubation of the cells in the presence of the antibiotic at these same levels.

Circulin adsorbed by the cell wall (Fraction I) was partially removed through elution with 0.1 N HCl, while that in the cytoplasmic membrane (Fraction II) seemingly was more firmly held.

Calculations based on the number of molecules of circulin adsorbed by each fraction at saturation indicated a potential monolayer of circulin on Fraction I (cell wall), and only one-tenth of a monolayer on Fraction II (cytoplasmic membrane).

These data are interpreted to suggest a two step reaction for circulin upon bacterial cells: 1) an adsorption of the antibiotic upon the surface of the cells at certain receptor sites, followed by 2) interference by circulin with the retentive properties of the cellular envelope resulting in the release of cytoplasmic materials and death of the cells. 115 pages. $1.44. Mic 56-1336

EQUILIBRIUM IN THE FIBRINOGEN-FIBRIN CONVERSION

(Publication No. 15,594)

Thomas Henry Donnelly, Ph.D.
Cornell University, 1955

This study has been carried out to verify the proposal of Laskowski, Rakowitz and Scheraga that the conversion of fibrinogen to fibrin is composed of a series of reversible steps, and that the equilibrium constants governing these steps are measurable.

The above authors have proposed the following reaction scheme:

$$1)\quad F \overset{T}{\rightleftharpoons} f + P$$

$$2)\quad nf \rightleftharpoons f_n$$

$$3)\quad mf_n \rightleftharpoons \text{Fibrin clot}$$

Of these steps, Step 2 has been shown to be reversible by Scheraga and Backus as well as by Ferry and co-workers. That the combined steps 2 and 3 can be reversed to f is shown by the dissolution of fibrin clots, as reported by various workers. The present study provides further evidence for the reversibility of steps 1 and 3.

The reversibility of Step 3 has been verified by dissolving fibrin clots at a pH of 6.1 to the extent of about 10 mg./ml. in 1M NaBr. Presence of polymeric intermediates under these conditions was verified by analysis of the sedimentation patterns obtained in the ultracentrifuge. Incident to this study, a method of preparation of highly concentrated and reactive solutions of f has been developed. Essentially, this involves a process of dissolution of fibrin clots in 1M NaBr at a pH of 5.3, and recycling the resulting solution through clotting and dissolution stages.

The reversibility of Step 1 has been verified by estimating the amount of f present in a mixture of fibrinogen incubated with thrombin under conditions such that steps 2 and 3 do not take place. The method developed for such studies is based on the preferential action of thrombin on the substrate, p-toluenesulfonyl-L-arginine methyl ester (TAMe), as reported by Sherry and Troll. Using the solutions of f described above, it has been possible to calibrate the clotting of mixtures of fibrinogen, fibrin and thrombin in a medium containing TAMe in order to account for occlusion on the fibrin clots in the analysis for f. Using such a calibration, the amount of f in mixtures formed by the action of thrombin on fibrinogen in 1M NaBr at a pH of 5.3 has been measured and found to correspond to a value less than the stoichiometric amount. The equilibrium of Step 1 can be shifted to the right by allowing Step 2 to take place. Further, the equilibrium position of Step 1 can be approached from the reverse direction, i.e., by reaction of f and P. All these results have been qualitatively verified by analysis of the non-protein nitrogen (i.e., P) produced by the action of thrombin on fibrinogen.

Using the averages for a series of studies made using the TAMe method, we propose the following values for the physico-chemical parameters for Step 1 at 15° C.:

$\triangle H_{act.}$ = 14 kcal./mole
$\triangle H^0$ = 21 kcal./mole
$\triangle F^0$ = 5.2 kcal./mole
$\triangle S^0$ = 56 cal./mole/degree

It is also indicated that only one species (i.e., P) is evolved other than f by the action of thrombin on fibrinogen.

These results may be interpreted in the light of Laskowski and Scheraga's study of the thermodynamic stabilization of peptide bonds by hydrogen bond formation in protein molecules. Thus, it may be estimated that a net of about 5 hydrogen bonds must be broken in producing a molecule of fibrin monomer from one of fibrinogen.

163 pages. $2.04. Mic 56-1337

STUDIES ON CARBOHYDRATE METABOLISM IN VITRO AS AFFECTED BY INSULIN AND OTHER FACTORS

(Publication No. 16,310)

Doris F. Dunn, Ph.D.
Temple University, 1956

Conditions have been established for optimal oxidation of carbohydrate substrates by whole, cell-free homogenates of various rat tissues. These conditions include homogenization and incubation of the tissue in a buffered isotonic potassium-rich medium, fortified with magnesium, phosphate, and relatively large amounts of DPN. In such a medium, whole homogenates of rat heart, kidney, brain, and liver were able to convert appreciable quantities of exogenously added glucose-C^{14} to $C^{14}O_2$. Added ATP was not required for optimal glucose oxidation by most tissues; in fact the coenzyme was inhibitory at high concentrations. Of the various tissues tested, only brain homogenates were stimulated by the addition of ATP to the DPN-fortified system. This tissue was also anomalous in that it was not particularly dependent upon added DPN for optimal glucose oxidation in the homogenate system.

Muscle homogenates, which did not oxidize glucose in this medium, were able to do so when the system was fortified with added yeast hexokinase. Addition of this enzyme also stimulated glucose oxidation by liver homogenates but did not enhance the conversion of glucose to fatty acids by hepatic tissues.

Most tissue homogenates were able to oxidize fructose at rates comparable to their rates of glucose oxidation. The requirements for optimal fructose oxidation appear to be the same as those for glucose.

Since all the enzymes of glucose oxidation are apparently present and functional in this homogenate system, any direct action insulin may have on the enzymatic steps of glucose oxidation should be demonstrable in such a system. However, attempts to show a stimulatory effect of insulin on glucose oxidation by homogenates of various rat tissues under optimal conditions were never successful. These consistent negative data suggest that insulin does not act directly on the enzymes involved in glucose oxidation. Insulin was also unable to restore glucose oxidation in homogenates which were deficient in various constituents of the medium. The hormone was without effect in systems which contained suboptimal concentrations of glucose substrate, hexokinase, magnesium, potassium, phosphate, ATP, or cytochrome c.

Addition of relatively large amounts of growth hormone to kidney homogenates in vitro markedly inhibited glucose oxidation, especially when cytochrome c was omitted

from the medium. Insulin failed to restore oxidation in such a growth hormone-inhibited system, except in several isolated instances. Since the effect was not consistent, it could not be considered significant.

In contrast with the negative results in homogenates, slices of some rat tissues, namely diaphragm, adipose, and kidney, appeared to exhibit slight enhancement in glucose oxidation in the presence of insulin. However, the effect was too small to be claimed with certainty.

In addition to the studies in vitro, an in vivo technique has been employed whereby the turnover rate, or rates of production and utilization, of blood glucose may be calculated. This technique enables the calculation of the normal turnover rate at a constant blood sugar level, as well as the deviation from normal during a period of changing blood sugar level, such as after insulin administration. By administration of glucose-C^{14} to intact animals and analysis of the concentration and radioactivity of the glucose in blood samples taken periodically thereafter, the rates of production (i.e., appearance into the blood stream) and utilization (i.e., disappearance from the blood stream) of blood glucose may be calculated. Preliminary studies on rats and rabbits indicate that the lowering of the blood sugar after insulin administration is a result of both inhibition of production and enhancement of utilization. The mechanism whereby insulin effects these changes remains for elucidation. 148 pages. $1.85. Mic 56-1338

A STUDY OF THE KINETICS OF RAT LIVER LACTIC DEHYDROGENASE

(Publication No. 16,425)

Sister Mary Emeran Foley, O.S.F., Ph.D.
University of Illinois, 1956

Lactic dehydrogenase is assumed to form two ternary complexes--one with both substrates involved in the system from the lactate side of the reaction, L-lactate and DPN^+, and one with both substrates from the pyruvate side, pyruvate and DPNH and also in this case with H^+. This is described by the following equation:

$$L + LDH + DPN^+ \underset{k_2}{\overset{k_1}{\rightleftharpoons}} L\cdot LDH\cdot DPN^+$$

$$P\cdot LDH\cdot DPNH\cdot H^+ \underset{k_4}{\overset{k_3}{\rightleftharpoons}} P + DPNH + H^+ + LDH$$

The Strauss-Goldstein theory has been extended to a two-substrate system and expressions for the dissociation constants for both complexes derived:

$$K_{M_1} = \frac{(1 - a)\ (L)\ (DPN^+)}{a}$$

$$K_{M_2} = \frac{(P)\ (DPNH)\ (1 - a)\ (H^+)}{a}$$

Fractional activity, a, defined as $a = \frac{v}{V_M}$, was calculated as the ratio of the initial reaction velocity at given concentrations of substrates to the maximum initial reaction velocity at infinite concentrations of both substrates. Reaction velocities were determined spectrophotometrically and expressed in terms of DPNH concentration changes in the cuvettes. Measurements were made at a given enzyme concentration with varying concentrations of the two substrates. Substitution in the equilibrium formulas above gave the following average values: $K_{M_1} = 2.9 \times 10^{-5}$; $K_{M_2} = 2 \times 10^{-16}$. The definitions of K_{M_1} and K_{M_2} are the same as those designated by Alberty as K_{AB} and K_{CD}. Substitution of the experimental values in Alberty's expression for the overall constant of equilibrium,

$$K_{eq} = \frac{V_{Mf}\, K_{CD}}{V_{Mr} K_{AB}},$$

gave a value 0.69×10^{-11}.

Inhibition by pyridine-3-sulfonic acid appeared to be competitive with respect to both substrates, L-lactate and DPN^+, according to the traditional interpretation of inhibition curves. The calculated value for the inhibitor constant, K_I, at a P-3-S concentration of 0.0375 M was 0.1. Further detailed studies of the inhibition of LDH by various compounds will be required to help provide insight into the mechanism of the reaction and the nature of the catalytically active site. 79 pages. $1.00. Mic 56-1339

CHEMICAL SYNTHESIS OF FLAVIN NUCLEOTIDES

(Publication No. 16,536)

Gordon Leslie Kilgour, Ph.D.
University of Washington, 1956

A number of methods were investigated for the chemical synthesis of flavin nucleotides. The synthesis of riboflavin-5′-pyrophosphate from riboflavin-5′-phosphate was attempted using a variety of phosphorylating agents, the most suitable being phosphoric acid in the presence of di-p-tolyl carboddimide. By means of this reaction, and subsequent isolation of the product by large-scale paper chromatography, riboflavin-5′-pyrophosphate was obtained in pure form. During these studies, solvent systems and techniques of paper chromatography were developed for the isolation and identification of small quantities of flavin nucleotides of closely similar structure.

The chemical synthesis of flavin-adenine-dinucleotide was also accomplished through condensation of riboflavin-5′-phosphate with adenosine-5′-phosphate in the presence of a carbodiimide. The analogous inosine nucleotide, flavin-inosine-dinucleotide, was prepared in the same manner by substituting inosine-5′-phosphate for adenosine-5′-phosphate. Both products were isolated by methods of large-scale paper chromatography.

67 pages. $1.00. Mic 56-1340

COENZYME A, ACETYL COENZYME A, AND S. FECALIS GROWTH FACTOR; PURIFICATION AND DETERMINATION

(Publication No. 16,184)

Milton Lapidus, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor F. M. Strong

A quick, economical method is now available for the concentration of coenzyme A by means of a Florosil column.

Coenzyme A and acetylated coenzyme A can be purified by means of Dowex 1 resin columns. Development elution with ammonium formate-formic acid solutions revealed various adenine absorbing peaks. Not all the peaks obtained were enzymatically active to the phosphotransacetylase assay in the case of coenzyme A and to the transacetylase assay in the case of acetyl coenzyme A.

Acetylation of coenzyme A with sodium thiolacetate is not specific for the sulfhydryl group. This is a limiting factor in the preparation of enzymatically active acetyl coenzyme A.

The determination of acetyl coenzyme A by means of the hydroxamic acid method and the transacetylase method have been investigated and found of value in determining the extent of acetylation of coenzyme A as well as purity.

Further evidence that chicks require unidentified growth factors present in penicillin and streptomycin mycelium have been obtained.

The chick growth factor and the S. fecalis factor have not been shown to be identical in this laboratory. The similarity of these factors as claimed by the research workers at the Squibb Institute for Medical Research could not be substantiated or the discrepancy in results resolved.

Partial purification of approximately seventeen fold of the S. fecalis factor has been realized by "salting in" the activity into butanol with ammonium sulphate and partition chromatography of the activity on a silicic acid column.

143 pages. $1.79. Mic 56-1341

ACTION OF SODIUM HYPOCHLORITE ON CORN STARCH AMYLOSE

(Publication No. 16,477)

Ernest George Linke, Ph.D.
Purdue University, 1956

Major Professor: Dr. Roy L. Whistler

Oxidation of starch to modify its properties is an important commercial operation. A common agent for oxidizing starch is sodium hypochlorite. This investigation is undertaken to learn more about hypochlorite oxidation.

Amylose, prepared by 1-butanol fractionation of corn starch, is oxidized in the dark at 25° with various levels of sodium hypochlorite at pH 9 and 11. Oxidations at pH 9 proceed more rapidly and are attended with less amylose retrogradation than oxidations at pH 11. Retrogradation decreases at each pH with increased amount of sodium hypochlorite consumed.

The principal reaction, other than oxidative depolymerization of the chain, is a carbon-carbon bond cleavage of the anhydroglucose residues between carbon atoms 2 and 3 of the ring with formation of carboxyl groups. Isolation of D-erythronic acid and glyoxylic acid from the hydrolyzate of oxidized and dialyzed amylose supports this conclusion. D-erythronic acid is isolated as its lactone and glyoxylic acid is identified as its 2,4-dinitrophenylhydrazone.

Quantitative analysis of the glyoxylic acid present in the oxidized amylose hydrolyzates shows that 6 to 27% of the sodium hypochlorite is consumed in effecting 2,3-cleavage to the dicarboxylic acid structure. The nondialyzable oxidized products contain 0.34 to 13% of their residues as the 2,3-dicarboxylic acid structure.

Glucosidic bond cleavage is indicated by the fact that dialysis of the oxidized products removes about 25% of the original starting material. Presumably, a large portion of the sodium hypochlorite is consumed in processes leading to degradation of the amylose chain. As shown by chromatographic analysis, the dialyzates contain an unidentified component which constitutes the major portion of the organic material present. This seems to indicate degradation of the chain in a somewhat regular fashion.

Large numbers of D-glucose units in the chain remain unaffected during the oxidation since the hydrolyzate contains a large amount of D-glucose identified through its phenylosazone.

The 2,3-cleavage to the dialdehyde structure, which is characteristic of the action of periodic acid on amylose, apparently does not occur with hypochlorite. No glyoxal derivatives are isolated from the hydrolyzate. The formazan reaction given by periodic acid oxidized starch is negative when applied to sodium hypochlorite oxidized amylose. Neither glyoxal nor erythrose are detected by chromatographic analysis of the hydrolyzate.

Color reactions and chromatographic analysis fail to detect glucuronic acid and tartaric acid in the oxidized amylose hydrolyzate. Therefore, oxidation of primary hydroxyl groups of anhydroglucose residues is not a significant reaction.

Using the same level of oxidation per glucose unit at pH 9 maltose consumes sodium hypochlorite at a much more rapid rate than does amylose.

52 pages. $1.00. Mic 56-1342

STUDIES ON THE STRUCTURE OF STREPTOTHRICIN

(Publication No. 16,419)

Jack Vincent Pierce, Ph.D.
University of Illinois, 1956

INTRODUCTION

Acid hydrolysis of the antibiotic streptothricin yields ammonia, carbon dioxide, and four ninhydrin positive components--Compounds A, B, C, and X_1. Compound A has been proved to be (+)-β,ϵ-diamino-n-caproic acid (1) and given the trivial name β-lysine. Compound B, identical with streptolidine obtained from acid hydrolysis of streptolin (2), has been postulated to be either 2-imino-4(or 5)-(β-amino-α-hydroxyethyl)-5(or 4)-imidazolidine carboxylic

acid (3) or 2-imino-4(or 5)-(α-isoerinyl)-imidazolidine (4). Compound C has been isolated as an amorphous powder with several properties of a hexosamine (5).

DISCUSSION OF RESULTS

Compound C was purified by pretreated charcoal chromatography and crystallized as the hydrochloride salt ($[\alpha]_D^{25}$ -29.5°, m. p. 225-233° dec.), which gave correct analytical data for $C_{13}H_{25}N_5O_7 \cdot 2HCl$. Compound C instantaneously reduces four moles of periodate per mole at pH 4.5 with the liberation of one mole of formaldehyde, two moles of ammonia, and three moles of formic acid. Prolonged acid hydrolysis of C produces streptolidine and Compound X_2, which is probably a 2-aminopentose.

Degradation of streptothricin with acid produces also a fast-moving spot on paper chromatograms which was designated Compound X_1. This compound ($[\alpha]_D^{25}$ +35°, m. p. 248-255° dec.) gives correct analytical data for $C_6H_{11}NO_4 \cdot HCl$. Compound X_1 is non-reducing and Elson-Morgan negative. The infrared spectrum is consistent with a 2-methylol-3,4,5-trihydroxy-Δ^2-piperidine hydrochloride structure.

Hydrolysis of streptothricin with p-toluenesulfonic acid yields β-lysine, streptolidine, a slow-moving ninhydrin and Weber positive component which is not streptothricin, and a ninhydrin negative and Weber positive substance designated Compound E (m. p. 260-270°). Analytical data indicate E to be $C_6H_{10}N_4O_2 \cdot HCl$. Acid hydrolysis of E gives spots for streptolidine and an unidentified ninhydrin positive, Weber negative component. Neither streptolidine nor E are altered by prolonged hydrolysis with p-toluenesulfonic acid, indicating that two competing modes of cleavage are operative in the original hydrolysis of streptothricin with p-toluenesulfonic acid.

Mild treatment of streptothricin with barium hydroxide has been shown to give one mole of carbon dioxide and a new compound, the Barium Hydroxide Product (BHP) (5). This compound, after pretreated charcoal chromatography, gives correct analytical data for $C_{19}H_{36}N_8O_8 \cdot 4HCl$. The analyses of the crystalline p-hydroxyazobenzene-p'-sulfonate salt are consistent with this formula. The BHP rapidly consumes two moles of periodate per mole at pH 4.5 with the liberation of one mole of formaldehyde, one to two moles of ammonia, and two moles of formic acid.

A partial structure for streptothricin consistent with most of the above information was formulated.

Acid degradation of a crude streptothricin preparation gave a twenty per cent yield of an amino sugar, Compound X_3 ($[\alpha]_D^{25}$ +94°, m. p. 183-200°). Analytical data are in agreement with $C_6H_{13}NO_4 \cdot HCl$. Periodate and other experiments indicate X_3 to be a 2-amino-methylpentose.

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228 pages. $2.85. Mic 56-1343

THE USE OF CHELATING AGENTS IN THE MICROELEMENTAL NUTRITION OF CORN

(Publication No. 16,487)

Gordon Keith Rasmussen, Ph.D.
Purdue University, 1956

Major Professor: Raymond E. Girton

Four phases of the problem were investigated: first, microelements were added to nutrient solutions in chelate form and deficiency symptoms were determined when Fe, Cu, Mn, Zn, or Mo was absent; second, antagonistic effects were studied; third, the effect of chelates upon the respiration of primary corn root tips; and fourth, the effect of chelates upon the cytochrome-oxidase and polyphenol-oxidase activities of corn-seedling homogenates.

For the deficiency studies corn seedlings were used from which the grain and primary roots were removed after development of the adventitious roots. The seedlings were started in silica sand but the deficiency symptoms were determined in plants growing in nutrient solutions in 4-liter-plastic refrigerator dishes.

Primary corn root tips from seedlings grown in ½ sat. $CaSO_4$ solution for 2 days in the dark and 3 days in the light were used for the second phase. Respiration rates were determined by the manometric measurement of O_2 uptake.

The root tips for the third phase were cut from seedlings which had been grown under semi-sterile conditions on deionized-water-saturated filter paper in "Petri" dishes at 22°-24° C. The twenty root tips were placed in another "Petri" dish containing a solution of the microelements whose antagonistic effects were to be determined. Antagonism studies were carried out for 5, 10, 15, and in some cases 20 hours.

Homogenates were prepared from corn seedlings by grinding the seedlings with a buffer and sand and pressing the extract through broadcloth. The activities of the enzyme systems were determined manometrically.

Corn plants showed typical symptoms when grown in Fe, Mn, and Zn-deficient nutrient solutions. Chelated microelements may be added in higher concentrations than the corresponding salts without exhibiting any toxic effects by the plants.

Respiration of root tips was inhibited by Na_4EDTA. This inhibition was partially reversed by additions of Fe, Cu, Mn, and Ni. All of these metals are chelated strongly by Na_4EDTA. Li, which is chelated 4 to 9 times less strongly by Na_4EDTA did not reverse this inhibition.

Antagonistic actions between various microelements were evident in some studies regardless of whether the microelements were chelated or were in the ionized form. Antagonism was measured by the effect of the microelements on the respiration and growth of root tips. Cobalt

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in the presence of Na_4EDTA is taken up by the root cells faster than Co in $CoCl_2$ solutions. Also, CoEDTA inhibited the O_2 uptake by the cytochrome system of 2-day-old seedling homogenates.

Oxygen uptake by the cytochrome system of 2-day-old seedling homogenates was inhibited 65 per cent by 4 meq./L. Na_4EDTA. This inhibition of O_2 uptake was partially reversed by $FeCl_3$. The polyphenol-oxidase activity of $6\frac{1}{2}$-day-old seedling homogenates was also inhibited by Na_4EDTA and this inhibition was partials by $CuSO_4$.

130 pages. $1.63. Mic 56-1344

A STUDY OF LIPOGENESIS IN CELL-FREE SYSTEMS

(Publication No. 16,344)

Walter Norman Shaw, Ph.D.
University of Pennsylvania, 1956

Supervisor: Samuel Gurin

Previous in vitro studies with rat liver slices have indicated that normal lipogenesis is dependent upon an efficient glycolysis. A study of lipogenesis in general and its relationship to glycolysis has been carried out using cell-free preparations of rat and pigeon liver.

The liver was first homogenized in phosphate buffer from which mitochondria were isolated and a particle-free supernatant fluid obtained. The cell-free preparation of the rat was obtained by combining an aqueous extract of the mitochondria with the supernatant fluid. The cell-free preparation of the pigeon was obtained by combining a phosphate buffer extract of a mitochondrial acetone powder and the supernatant fluid.

The normal rat system incorporated 1-C^{14}-acetate, 2-C^{14}-acetate, 2-C^{14}-pyruvate, and 1-C^{14}-acetyl CoA into long chain fatty acids. The cell-free systems prepared from alloxan diabetic rat liver did not synthesize fatty acids from any of these substrates. The addition of glycogen, glucose-6-phosphate, fructose, fructose-6-diphosphate, fructose-1,6-diphosphate, 3-phosphoglyceraldehyde, and phosphopyruvate to the diabetic cell-free system restored lipogenesis. The addition of fructose-1,6-phosphate plus ADP and phosphopyruvate plus ADP effected the greatest restoration. The addition of glucose with or without insulin had no effect.

The normal cell-free system of pigeon liver incorporated 2-C^{14}-acetate and 2-C^{14}-pyruvate into long chain fatty acids. The system prepared from pigeon liver eight days after pancreatectomy did not synthesize fatty acids. The addition of glycogen, glucose-6-phosphate, fructose-1,6-diphosphate and normal supernatant fluid restored lipogenesis.

The biosynthesis of fatty acids from 2-C^{14}-pyruvate was also achieved with normal rat mitochondria alone, when butyryl CoA is supplied along with Mg ions, DPN, and citrate. Diabetic mitochondrial systems supplemented with butyryl CoA exhibited no depressed lipogenesis and were not affected by the addition of fructose-1,6-diphosphate. In these systems, butyryl CoA appears to be able to replace the supernatant fluid.

It appears that the inability of glucose to be phosphorylated in the diabetic liver prevents glycolysis from supplying some necessary factor or factors. The results do not indicate conclusively how glycolysis is linked with lipogenesis.

The addition of citrate to the cell-free systems stimulated lipogenesis. In the liver mitochondrial system, citrate stimulated lipogenesis in the presence of small amounts of butyryl CoA (2-5 uM). There was no requirement for citrate when large amounts of butyryl CoA (25 uM) were used. It is proposed that citrate blocks or inhibits the enzyme, acetoacetyl CoA deacylase, and allows the acetoacetyl CoA to be utilized for fatty acid synthesis.

2-C^{14}-sodium pyruvate was prepared by treating 2-C^{14}-pyruvamide at low temperatures with nitrous acid.

183 pages. $2.29. Mic 56-1345

THE PATHWAY OF THE GLUCONATE FERMENTATION BY STREPTOCOCCUS FAECALIS

(Publication No. 16,428)

John Robert Sokatch, Ph.D.
University of Illinois, 1956

The Embden-Meyerhof nature of the fermentation of hexoses by the homolactic acid bacteria has been well established. However, many of the structural and coenzyme components of these bacteria, in particular the pentoses and deoxypentoses, would be difficult to conceive of as being derived from Embden-Meyerhof intermediates. For this reason, the possibility that these bacteria are also capable of an alternate mechanism to the Embden-Meyerhof scheme was considered. Since most of the known alternate schemes go through gluconate as an intermediate, the organism used for study, Streptococcus faecalis, strain 10Cl, was grown on this substrate as an energy source.

Studies with whole cells revealed that this organism was capable of converting the entire gluconate molecule to 0.5 mole CO_2 and 1.83 moles lactate per mole of substrate. Both glucose and gluconate gave approximately equal cell yields, which is interpreted as meaning that the energy yield per mole of gluconate is very nearly the same as that for glucose. Both glucose and gluconate fermentations are sensitive to fluoride, the concentrations required for 50% inhibition being, glucose, 6.2×10^{-3} M and gluconate, 2.4×10^{-3} M. The gluconate fermentation is not sensitive to arsenite at a concentration which inhibits pyruvate oxidation 100%, which would rule out a lipoic acid mediated oxidation of pyruvate as being on the pathway to CO_2.

The fermentation of gluconate-1-C^{14} yields radioactive CO_2 and carboxyl labeled lactic acid, while gluconate-6-C^{14} yields only methyl labeled lactic acid. Gluconate-2-C^{14} however, yields unlabeled CO_2 but the lactic acid is labeled in every position with the carbinol carbon having a specific activity 2 to 3 times that of the other two positions. These data are compatible with a mixed fermentation scheme involving oxidation of one mole of gluconate to CO_2 plus pentose phosphate and subsequent fermentation of the pentose phosphate by way of the pentose phosphate pathway, while another mole of gluconate is cleaved to pyruvate plus triose phosphate with reduction of the pyruvate to lactate.

Studies with cell free extracts revealed the presence of

most of the enzymes required for the transformations indicated by the labeling data. Gluconokinase, 6-phosphogluconate dehydrogenase and the enzymes which convert pentose phosphate to heptulose phosphate were all detected. The aldolase which cleaves 2-keto-3-deoxy-6-phosphogluconate to pyruvate and triose phosphate was also found, but the dehydrase for 6-phosphogluconate was detected in only trace amounts. The enzyme, transaldolase, was also found to be limiting. It appears as though either the 6-phosphogluconate dehydrase and transaldolase of S. faecalis differ in properties from those described for other organisms or enzymes which accomplish similar purposes are present, but not yet detected.

72 pages. $1.00. Mic 56-1346

STUDIES ON THE RESPIRATION OF ASHBYA GOSSYPII, A RIBOFLAVIN PRODUCING ORGANISM

(Publication No. 16,363)

Ann Rita Stasch, Ph.D.
The University of Florida, 1956

This investigation of the respiration of Ashbya gossypii, both under those conditions where it produces riboflavin and under those where it does not, was undertaken in an effort to find information on the possible metabolic changes associated with the synthesis of riboflavin.

Several factors, including the position of the thermobarometer on the water bath, the rate of shaking of the Warburg, the concentration of glucose used as substrate, the concentration of inoculum and the effect of cold storage were investigated in order to determine the optimal conditions for respiration measurements on the cell suspensions.

Using different ages of cells from four different media- peptone, glutamic acid-arginine, glutamic acid-arginine-leucine and glutamic acid-arginine-leucine-histidine- it was found that actively metabolizing cells had a higher respiration than older cells when growth was normal. With the last two media, however, an inhibition or delay of growth occurred and cells from these media showed peaks in respiration during slow growth. These were postulated to be associated with the synthesis of substances required for growth.

The addition of riboflavin to peptone cells showed almost the same increase in respiration as did the addition of glucose to the concentrations studied. If this effect was due to oxidation of riboflavin rather than to stimulation of endogenous respiration, it may explain why riboflavin does not usually appear in appreciable amounts in non-inhibiting growth media until after the rapid growth phase.

Using suspensions of cells from three different media- peptone, glutamic acid-arginine, and glutamic acid-arginine-glycine- with various nitrogen sources as substrates, it was found that xanthine and guanine, of the purines used, showed some effects on all of the media. Of various amino acids used, proline, alpha-alanine, and glycine showed effects proportional to growth. Effects obtained with serine, glutamic acid, asparagine and tryptophan indicated a possible relationship to riboflavin formation.

The addition of water and acetone extracts of cells to peptone-yeast extract cells gave very large increases in endogenous respiration and small increases in respiration in the presence of glucose. This appeared to be related to a stimulation of endogenous respiration rather than to oxidation of substances present in the extract. Chromatographed portions of the extract showed very slight effects on respiration of peptone-yeast extract cells. This may have been due to too great dilution or, perhaps, to a destruction or separation of active components during chromatographing.

On a basis of findings in this investigation, further work would seem to be indicated on the function of glycine, serine, glutamic acid, arginine, tryptophan, leucine, histidine, xanthine and cell extracts as possible intermediates or starting compounds in the synthesis of riboflavin.

123 pages. $1.54. Mic 56-1347

AN ELECTRON MICROSCOPIC EXAMINATION OF THE FORMATION OF STARCH GRANULES IN CORN ENDOSPERM

(Publication No. 16,497)

Wendell Lewis Thornburg, Ph.D.
Purdue University, 1956

Major Professor: Roy L. Whistler

This thesis problem has consisted of two parts, a) an electron microscopic examination of the surface structure of starches of different genera, and b) an electron microscopic examination of the development of starch granules in corn endosperm at different stages of maturity.

Replicas of the surface structure of various starches were prepared using the agar-collodion and the silicon dioxide-cellulose nitrate methods. Evidence obtained by these methods suggests that the surfaces of native starch granules are remarkably smooth. Numerous observations of ultra-thin sections have shown a rather uniformly smooth outline without evidence of extensive wrinkles, crevices or pits.

Granules of different genera have distinctly different surface characteristics. These differences could explain many of the differences in chemical and physical properties of starches.

These replica techniques offer a new method for the identification of starches of different genera.

The electron micrographs presented show that starch granules in corn endosperm are formed as early as 4 days after pollination. This is the first reported observation that starch granules of corn endosperm are formed earlier than 10 days after pollination.

The rupture of the amyloplast membrane is a possible explanation of the fact that lamellae are observed in less than 15% of the granules. Granules originate in amyloplasts which often rupture as the granules mature.

Diffusion of soluble carbohydrates from the proximal to distal end of the kernel could explain the observation that, as one proceeds from a point approximately 15 cells in from the aleurone, granules decrease both in size and in number going from this point either to the center or periphery.

Central cavities were rarely observed in undried

granules and sections 0.1μ in thickness, fail to exhibit birefringence regardless of the stage of maturity.

A new, dependable and rapid procedure has been developed for the preparation of silica coated grids. This procedure may also be used for the preparation of other metallic membranes. 51 pages. $1.00. Mic 56-1348

STUDIES ON THE MECHANISMS OF PYRIMIDINE BIOSYNTHESIS

(Publication No. 16,352)

Ray J. Wu, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. D. Wright Wilson

Several aspects on the mechanism of pyrimidine biosynthesis in rat liver have been explored. (a) The conversion of radioactive barbituric acid to acid soluble uracil and nucleic acid uridylic acid has been studied. With rat liver slices and homogenates, however, no evidence was found to support this idea. (b) The incorporation of tagged precursors into polynucleotide pyrimidines is rather slow. Using C^{14}-labeled ureidosuccinic acid and orotic acid as precursor, we found that the specific activity of acid soluble uracil was from 40-50 times higher than that of the nucleic acid uridylic acid. As acid soluble uridylic acid may be converted into nucleic acid uridylic acid and as acid soluble uracil is formed from acid soluble uridylic acid, acid soluble uracil is a convenient compound for studying the pathway of pyrimidine biosynthesis. (c) The problem of whether orotic acid is on the direct pathway of pyrimidine nucleotide synthesis has never been settled. We now have evidence that adenosine triphosphate is not required in orotic acid synthesis from ureidosuccinic acid, and have isolated orotic acid per se with undiluted radioactivity. Both facts support strongly the idea that orotic acid is on the direct pathway. (d) The role of aminofumaric acid diamide has not been uniform in mutants of Neurospora and livers of rats. We have found in rats, an alternative pathway of pyrimidine biosynthesis as aminofumaric acid diamide is incorporated into acid soluble uracil without passing through aspartic acid and orotic acid. An explanation is given to conciliate all of the known facts. (e) With fractionated homogenates of rat liver, the nuclear, mitochondrial and microsomal fractions were found to be almost equally active in converting ureidosuccinic acid to orotic acid, while the supernatant fraction was totally inactive. The optimum conditions for this conversion were studied. (f) The enzyme systems in the particles were solublized with 1% digitonin as the lysing agent. With the charcoal treated water-soluble extract, the requirement of diphosphopyridine nucleotide has been established, but no requirement for adenosine triphosphate, coenzyme A or magnesium ions could be demonstrated.

105 pages. $1.31. Mic 56-1349

CHEMISTRY, INORGANIC

A STUDY OF SOME METAL-METAL OXIDE SOLID SOLUTIONS

(Publication No. 15,588)

Lawrence Edward Conroy, Ph.D.
Cornell University, 1955

A study has been made of the formation of solid solutions of metals in certain metal oxides. Previous workers had shown that solid solutions of the alkali metals in tungsten trioxide could be prepared. Such solutions showed striking properties such as high metallic electrical conductivity, weak paramagnetism, metallic luster, color, and extreme chemical inertness.

In this thesis research it has been found possible to prepare solid solutions of metals other than the alkali metals in tungsten trioxide by electrolytic reduction of tungstate-tungsten trioxide melts. Copper solutions in tungsten trioxide of varying non-stoichiometric copper content have been prepared. Solid solutions containing (1) silver in tungsten trioxide and (2) lead in tungsten trioxide have been prepared but it has not been established that the ratio of metal to tungsten trioxide is variable. In all three cases, the products have been shown still to contain the respective metals after treatment with concentrated mineral acids, aqua regia, and aqueous hydrofluoric acids. The lead solution displays color, metallic luster and good electrical conductivity like the prototype alkali metal solid solutions. The copper and silver solutions do not show these same properties although the electrical conductivity of the copper solid solution is higher than that of typical ionic compounds.

Attempts to prepare solid solutions of metals in tungsten trioxide by solid state reactions at elevated temperatures were somewhat inconclusive. In the cases of magnesium, calcium, zinc, and cadmium products were obtained which contained the metals in appreciable amounts even after treatment with concentrated mineral acids, aqua regia, and aqueous hydrofluoric acid. These products were good electrical conductors and were colored. Powder x-ray photographs of the substances did not coincide with those for any of the oxides of tungsten but none of the patterns was successfully indexed.

All attempts to produce solid solutions of metals in other oxides failed. Reduction of melts containing chromium trioxide or molybdenum trioxide only produced lower oxides of chromium or molybdenum. Reduction of alkali melts containing titanium dioxide gave no identifiable products. Alundum and ferric oxide gave only reduction products when reacted with alkali or alkaline earth metals at high temperatures.

Some physical properties of the copper solid solution in tungsten trioxide have been measured. Two phases, an orthorhombic phase with approximate lattice parameters $a = 3.88\text{Å}$, $b = 3.73\text{Å}$ and $c = 7.74\text{Å}$, and a monoclinic phase with $a = 4.73\text{Å}$, $b = 4.90\text{Å}$, $c = 5.87\text{Å}$, and $\beta = 96.6^\circ$ have been found. The magnetic susceptibility of a solution having the composition $Cu_{0.26}WO_3$ was measured as $\chi_M = +34 \times 10^{-6}$. The electrical conductivity of monoclinic form crystals of the solution $Cu_{0.78}WO_3$ was measured as a function of temperature. The temperature coefficient of conductivity was found to be positive, and the activation energy for the conduction process was 0.146 electron-volts.

The room temperature specific resistivity was about 17 ohm-cm parallel to the long crystal axis and about 12 ohm-cm perpendicular to the long axis. Attempted measurements of the Hall coefficient of the solution $Cu_{0.78}WO_3$ gave a carrier mobility upper limit of 2.5 cm^2 per volt second. 46 pages. $1.00. Mic 56-1350

A STUDY OF THE REACTION AND PRODUCTS OF THE FLUORINATION OF THE CYANOGEN HALIDES

(Publication No. 16,320)

Howard Lee Craig, Jr., Ph.D.
University of Pennsylvania, 1956

Supervisor: Eugene R. Nixon

The fluorination of a molecule containing the cyanide group results in the formation of numerous, and in some cases, unusual products. In this study, the family of cyanogen halides, cyanogen chloride, cyanogen bromide and cyanogen iodide, were fluorinated in an attempt to better understand this type of reaction. The major product of such a reaction, in many instances, has been hexafluoroazomethane. An analysis of the structure of this molecule was made by interpreting the ultraviolet and infrared absorption spectra of the molecule, obtained in this work.

The cyanogen halide vapors were passed over a boat of silver difluoride which was heated to 100°C in a furnace. The reaction took place in an all-glass vacuum system. The volatile products were condensed in a trap cooled with liquid air. Nitrogen, formed in the reaction, was measured and then pumped off. The balance of the products was separated by trap-to-trap distillation. After separation of the unreacted cyanogen halide, the volatile products were conveniently divided into three fractions, one containing predominantly hexafluoroazomethane, and the other two, fractions having higher and lower boiling points than the hexafluoroazomethane fraction. Molecular weight determinations, by the vapor density method, were made on these fractions and various sub-fractions. Ultraviolet absorption spectra, made with a Beckman Model DU Spectrophotometer adapted for automatic recording, and infrared absorption spectra, made with a Perkin-Elmer Model 12-C Spectrometer, were obtained for all fractions and sub-fractions.

Chemical analyses were made of the solid residue left from the reaction. A determination of fluorine in samples of hexafluoroazomethane was made using a decomposition of the compound by sodium in liquid ammonia. Fluorine was determined gravimetrically as lead chlorofluoride, the other halogens as the silver salt and the silver content of the residue as either elementary silver or as the chloride.

The major product of the three reactions was hexafluoroazomethane. There were appreciable amounts of nitrogen and carbon tetrafluoride found in all cases. Accompanying the azo compound was a related molecule, not reported before in the literature: bis-trifluoromethylnitrosamine. All three fluorochloromethanes were identified as traces in the reaction with cyanogen chloride, as well as pentafluorochloroazomethane. The reactions with the two other cyanogen halides showed some oxygen-containing compounds: carbonyl fluoride, carbon dioxide and trifluoronitrosomethane. Silicon tetrafluoride was also found. The unstable compound bromine fluoride was identified as well as dibromohexafluoroazomethane. No fluorine-iodine compounds were detected, but something formed in the reaction with cyanogen iodide attacked the silicone stopcock grease to give unidentified compounds containing fluorine and probably silicones. Two compounds labeled "I" and "II" were found in all three reactions but could not be identified. Although the entire volatile products were thus accounted for, a material balance was unsuccessful. Analysis of the solid residue showed an enrichment of fluorine per mole of silver, not accounted for by formation of silver halide. No cyanide could be detected in the residue.

In view of the above observations, a mechanism for the formation of hexafluoroazomethane was proposed, involving the addition of the nitrogen to the silver atom while the carbon atom of the cyanide group is fluorinated. Upon heating, the trifluoronitrogen radical thus formed is dislodged and dimerizes into hexafluoroazomethane. The nitrogen and carbon tetrafluoride are formed, not from the decomposition of hexafluoroazomethane, but from the splitting of the trifluoronitrogen radical.

The infrared absorption spectrum of hexafluoroazomethane is interpreted to indicate that the molecule exists as both the cis and the trans isomer, the trans form being the more predominant product of these reactions. A reasonable assignment of the fundamental frequencies is made in the case of trans-hexafluoroazomethane. The relation between the spacing of the P and R branches in the triplet bands and the moments of inertia for a model of the trans isomer is considered, assuming the molecule to be a nearly symmetric top. 137 pages. $1.71. Mic 56-1351

THE CARBONATION OF WATER SOFTENING PLANT SLUDGE

(Publication No. 16,356)

Frederic Arnold Eidsness, Ph.D.
The University of Florida, 1956

A study has been made of the carbonation of the sludges obtained in softening the municipal water supplies of Gainesville, Florida and Dayton, Ohio by the lime-soda process. The volume concentrations of carbon dioxide have been limited to those of scrubbed stack gas and of the gas obtained by the recalcination of water softening sludge. The mol ratios of CO_2/MgO employed have been varied from 1:1, or 50 per cent of that required to convert all $Mg(OH)_2$ to the soluble bicarbonate to 10:1, or five times the theoretical requirement for complete conversion. Studies have been made both in the laboratory and in a pilot plant constructed especially for this work.

It has been found that carbon dioxide in concentrations varying from 10 - 33 per cent by volume exhibits a high degree of selectivity in converting insoluble $Mg(OH)_2$ to the soluble bicarbonate in the presence of much greater amounts of finely divided $CaCO_3$. The following statements summarize the effect of the several variables which were studied.

1. Conversion of $Mg(OH)_2$ to the soluble bicarbonate is

very rapid, above 96 per cent of that removed from the two sludges studied having been dissolved in the first 15 minutes.

2. The amount of $Mg(OH)_2$ dissolved is a function of the mol ratio of CO_2/MgO. The rate of solution of the $Mg(OH)_2$ increases rapidly up to a mol ratio of CO_2/MgO of 2:1. Beyond that point, as will be noted from the curves of Plates 3, 5 and 6, the relationship between the rate of solution of $Mg(OH)_2$ and the mol ratio of CO_2/MgO is linear.
3. Percentage removal of $Mg(OH)_2$ was not as great in the pilot plant as in laboratory experiments. This is believed to be due to the fact that dispersion of the gas in the sludge suspension was much more efficient, and bubble size much smaller in the laboratory absorber than in the pilot plant.
4. The percentage of gelatinous, highly hydrated magnesium hydroxide in both raw and carbonate sludges is found to be the main factor determining their settleability and final volume after settling. Converting most of the insoluble $Mg(OH)_2$ to the soluble bicarbonate is found to greatly reduce the time of settling and the final volume of the settled sludge.
5. This selective action of carbon dioxide on sludges composed of mixtures of $Mg(OH)_2$ and $CaCO_3$ has a number of interesting and promising practical applications, both in water treatment, and in the treatment and disposal of industrial wastes.

59 pages. $1.00. Mic 56-1352

STUDIES IN TRIFLUOROACETIC ACID

(Publication No. 16,532)

George Satsuki Fujioka, Ph.D.
University of Washington, 1956

The solubilities of CO_2, CO, Cl_2, HBr, HCl, H_2S, N_2, N_2O, PH_3 and SO_2 in trifluoroacetic acid were studied at about 26°C. In general, these gases were found to be more soluble in the acidic solvent than in water. The exceptions to this trend were gases such as HCl and HBr which are ionized in water. The solubilities of these two gases were more than a hundred times more soluble in water than in trifluoroacetic acid. Phosphine exhibits more than moderate solubility and may be behaving as a base in trifluoroacetic acid.

In the investigation of inorganic reactions in trifluoroacetic acid, the effects of HCl, H_2S, $HClO_4$, H_2SO_4, SO_3, H_3PO_4, HPO_3, Cl_2, CrO_3, H_2O_2, $KMnO_4$ and SO_2 on more than 25 dissolved metal trifluoroacetates were studied. The reactions obtained from H_2S closely parallel those obtained in acidic aqueous systems. More chlorides, perchlorates, sulfates and bisulfates were precipitated from trifluoroacetic acid than from water. The reactions with HCl and H_2SO_4 proceeded to completion in a large number of cases. The reactions obtained with SO_3 were similar to the reactions with H_2SO_4, but fewer reactions proceeded to completion. The reactions with H_3PO_4 were slow and only partially complete. The phosphate precipitates were often gelatinous.

The oxidizing activities of CrO_3, Cl_2 and $KMnO_4$ were still retained but diminished in trifluoroacetic acid. The manganese in $KMnO_4$ was reduced to Mn(III). Sulfur dioxide was able to reduce only the strong oxidizing agents such as CrO_3 and $KMnO_4$. Hydrogen peroxide was rapidly decomposed into water and oxygen by all the dissolved metal trifluoroacetates. In addition, $KMnO_4$ was reduced to Mn(II) and CrO_3 formed a peroxy-chromium compound.

Potassium permanganate reacted slowly with trifluoroacetic acid to give gaseous products of CO_2, CF_3COF and COF_2. The Mn(VII) was reduced to Mn(III).

115 pages. $1.44. Mic 56-1353

ANION EXCHANGE STUDIES OF FLUORIDE COMPLEXES

(Publication No. 16,358)

George B. Kauffman, Ph.D.
The University of Florida, 1956

The fluoride form of Dowex 1 has been prepared and characterized with respect to purity, thermal stability, bed density, and capacity, both wet and dry.

The limited solubility of transition metal fluorides, both in water and in excess potassium fluoride solutions, seems to indicate that if negative fluoride complexes exist at all, they are present in only very low concentrations.

Divalent manganese, iron, cobalt, nickel, and zinc have shown no anion exchange adsorption from potassium fluoride solutions in the concentration range investigated, and, therefore, presumably no complex fluoride anion formation occurs.

The anion exchange behavior of chromium(III) and copper(II) has not been consistent, and further work remains to be done. Spectrophotometric evidence for chromium(III) - fluoride complexes has been presented. "Adsorption" of copper(II) is believed to be caused by precipitation.

The adsorption of hydrofluoric acid by Dowex 1 has been observed, and the possibility of an anion exchange separation of this acid from "non-adsorbable" metal ions has been discussed.

The variation in anion exchange adsorbability of $FeF_6^{\equiv}$ with changes in hydronium ion concentration has been observed at two different ionic strengths. Weak acid formation has been postulated, and tentative values of

$$K_{\mu 0.350} = 3.1 \pm 0.3 \times 10^{-5}$$

and

$$K_{\mu 0.500} = 2.9 \pm 0.4 \times 10^{-5} ,$$

both at 25 ± 2°C., have been assigned to the reaction

$$HFeF_6^{=} + H_2O \rightleftharpoons H_3O^+ + FeF_6^{\equiv} .$$

The anion exchange adsorption of gallium(III) in potassium fluoride solutions ranging from 1.0×10^{-3} to 0.25 M has been investigated and the adsorbed complex has been found to be GaF_4^-. Since the adsorption is quite different from that of iron(III) under the same conditions, separation of the two trivalent metal ions should be possible.

142 pages. $1.78. Mic 56-1354

PROPERTIES AND VOLUMETRIC DETERMINATION OF ALUMINUM ION

(Publication No. 16,183)

Hisashi Kubota, Ph.D.
The University of Wisconsin, 1956

Supervisor: Associate Professor Walter J. Blaedel

There is a need for a good volumetric determination of the aluminum ion despite the existence of many published methods. The reactions that the aluminum ion can undergo which are of possible use in methods of determination are limited. Most of these reactions can take place only in a pH range where the aluminum ion undergoes considerable hydrolysis.

The extent and mechanism of the hydrolysis of aluminum in acid solutions were studied in order to determine the effect of this hydrolysis upon various volumetric methods. Studies were confined to acid solutions because fewer technical difficulties are met than in basic solutions.

The primary step in the hydrolysis of aluminum was found to be a distinct one-step protolysis of the aluminum ion which is independent of the total aluminum concentration over a 128-fold range. The reaction is:

$$Al^{+++} + H_2O = AlOH^{++} + H^+ .$$

The thermodynamic equilibrium constant for this reaction at 25° C was determined to be $9.4 \pm .3 \times 10^{-6}$. This protolysis is the only important reaction in neutral aluminum perchlorate solutions or ones containing excess free acid.

In the presence of base up to 0.50 mole per mole of aluminum, the data required a dimerization of the primary hydrolysis product:

$$2AlOH^{++} = (AlOH)_2^{++++} .$$

The thermodynamic constant for this reaction was estimated to be 6×10^3. This dimerization is rapidly reversible and does not affect the stoichiometry of the volumetric method which depends upon the reaction between aluminum ion and oxine. However, the presence of more base results in slow formation of basic polymers. These polymers are difficult to depolymerize by the addition of mineral acids, and they interfere with the stoichiometry of the reaction between aluminum and oxine.

The existing volumetric methods found in the literature are classified according to the type of reaction utilized. The accuracy of these methods as well as interferences are discussed.

An adaptation of a volumetric method utilizing the reaction between aluminum and oxine (8-hydroxy quinoline) also is described. 137 pages. $1.71. Mic 56-1355

STUDIES IN THE HIGH TEMPERATURE CHEMISTRY OF SILICON, GERMANIUM AND BORON

(Publication No. 16,484)

Clifford Earl Myers, Ph.D.
Purdue University, 1956

Major Professor: Alan W. Searcy

I. Dissociation Pressures of the Tantalum Silicides:

General trends in stability of carbides and nitrides of transition metals as well as high melting points and stability in high temperature chemical reactions lead to the expectation that the silicides of tantalum would be among the most stable of all silicides from a thermodynamic standpoint.

Accordingly, stabilities of all four tantalum silicide phases: $Ta_{4.5}Si$, Ta_2Si, Ta_5Si_3, and $TaSi_2$, have been determined from dissociation pressure measurements, and a high temperature quenching furnace was used to establish which modifications of the various phases were stable in the temperature range of the dissociation pressure measurements.

All the tantalum silicides were stable in the temperature ranges covered in the dissociation pressure measurements. No new modifications were observed. Only the modification reported by Brewer and co-workers were observed for $Ta_{4.5}Si$ and Ta_5Si_3. Other forms of these two phases which have been reported are probably low temperature or metastable modifications.

The calculated heats of dissociation were combined with the heat of vaporization of silicon to obtain the heats of formation of the tantalum silicides at 2000°K.: -52 ± 12 Kcal. for $Ta_{4.5}Si$, -47 ± 12 Kcal. for Ta_2Si, -29 ± 12 Kcal. for 1/3 Ta_5Si_3, and -25 ± 8 Kcal. for 1/2 $TaSi_2$.

II. Phase Modifications of $TaGe_{0.5}$:

Previous studies established the existence of three modifications of $TaGe_{0.5}$, but the existence of a fourth phase was postulated to explain the phase transitions observed in graphite crucibles. The present studies were in tantalum crucibles. β-$TaGe_{0.5}$ has been shown to be the stable high temperature form of this composition, α-$TaGe_{0.5}$ either is a low temperature form or is metastable, and γ-$TaGe_{0.5}$ is probably stabilized by a small percentage of carbon. The previously postulated high temperature phase apparently does not exist.

III. The Crystal Structure of Cr_5Si_3:

Cr_5Si_3 has been reported to be miscible with Fe_3Si_2 which has the Mn_5Si_3 structure. Hence, it was considered likely that Cr_3Si_2 was actually Cr_5Si_3 and was isostructural with Mn_5Si_3. Single crystals of Cr_5Si_3 were prepared by direct synthesis, and X-ray powder diffraction examination showed that Cr_5Si_3 is isostructural with the $MSi_{0.7}$ phase of tungsten and molybdenum which had not yet been solved. X-Ray examination by single crystal and powder techniques showed the unit cell to be tetragonal with $a = 9.170 \pm 0.006$ Å and $c = 4.636 \pm 0.003$ Å. The space group is 14/mcm.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

IV. The Vapor Pressure of Boron and of B_2O_3:

The vapor pressure of boron was measured by the effusion method and the results were combined with similar data collected earlier by the author to arrive at a value of 137.0 ± 4 Kcal. per gram atom as the heat of sublimation of boron at 298°K.

The reported vapor pressure of boric oxide was checked using the effusion method. The heat of vaporization was found to be 76.9 Kcal. per mole, in good agreement with the value of 77.6 Kcal. per mole reported earlier. 114 pages. $1.43. Mic 56-1356

INFRARED SPECTRA OF MOLECULAR CRYSTALS – DINITROGEN TETROXIDE AND SULFUR DIOXIDE

(Publication No. 16,350)

Robert Newman Wiener, Ph.D.
University of Pennsylvania, 1956

Supervisor: Eugene R. Nixon

The infrared spectra of molecular crystals provides information about intermolecular forces and crystal geometry as well as furnishing additional means of vibrational analysis of small molecules. According to the theories of Halford and Hornig, the selection rules for a vibrating molecular crystal may be found by first separating its potential function into lattice, internal and interaction terms. After the low frequency lattice terms have been factored out, a perturbation calculation may be applied by using the internal potential terms as the zeroth order approximation and the terms representing interaction between the internal normal coordinates and the equilibrium field of the crystal as the perturbation. A consequence of this is that the selection rules are governed by the symmetry of the center of gravity of the molecule in the crystal.

The group which multiplies as do the symmetry operations of such a point is called the site group. It is shown that the selection rules are found by considering the irreducible representations of the site group as components of the irreducible representations of the point group isomorphous with the unit cell group. When vibrations belong to a class in the site group whose irreducible representations are irreducible representations of an infrared active class of the unit cell point group, then such vibrations are infrared active.

Dinitrogen tetroxide was purified and its spectrum examined. The spectrum of the vapor is in accord with previous investigations.

The spectrum of crystalline N_2O_4 was observed using a modified Wagner low temperature cell. The spectrum agreed fairly well with prediction save that certain of the bands were split, which is not predicted and that ν_7, the out of plane bending is unexpectedly absent. These were explained on the basis of the nonequivalence of the sites in the crystal. There are six sites of symmetry V_h in the unit cell of symmetry T_h, but these six sites fall into two nonequivalent sets of three each. An alternative explanation for the absence of ν_7 is that the actual symmetry of the site is lower than that shown by x-ray investigations. C_{2v}, an admissible site group would predict the absence of ν_7. The reduction in symmetry may have been caused by the sampling method.

A mixture of 50% N_2O_4, 40% $N^{15}O_2$ - $N^{14}O_2$ and 10% $N_2^{15}O_4$ was prepared and its spectrum examined. A Teller-Redlich calculation for substitution in planar ethylenic X_2Y_4 was undertaken and the isotopic shifts calculated. The spectrum of crystalline $N_2^*O_4$ showed a band corresponding to ν_7 which would be predicted.

Finally, SO_2 was purified and its spectrum examined. All three fundamentals were infrared active as predicted. The band shapes are discussed in terms of temperature dependence of vibration rotation interactions.

101 pages. $1.26. Mic 56-1357

CHEMISTRY, ORGANIC

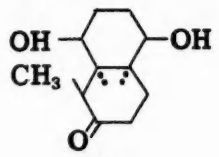
THE SYNTHESIS AND REACTIONS OF 3,4-DIHYDRO-2,5-DIMETHYL-6-VINYL-2H-PYRAN

(Publication No. 15,971)

Glen Edward Arth, Ph.D.
University of Minnesota, 1955

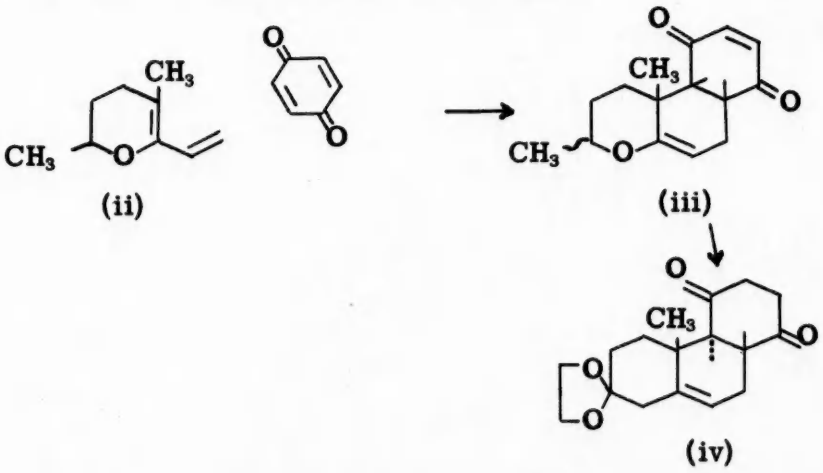
Major Advisor: Lee Irvin Smith

The total synthesis of adrenal hormones (1) achieved by chemists at Merck & Co., Inc., is reviewed. It is shown how, in the Merck synthesis, difficulties were encountered (but later solved) in applying the Robinson-Du Feu-McQuillin synthesis (2) to the diolone, (i). An alternative



(i)

solution to this difficulty is outlined, is described as the subject of the present investigation, and is shown to have been partially attained. The steps involved are: (a) The synthesis of (ii); (b) The reaction of (ii) with benzoquinone to provide (iii); and (c) The conversion of (iii) to (iv), an intermediate in the Merck total synthesis.



A six step synthesis of (vi) from (v) (3) and a proof of the structure of (vi) are described.

On a basis of orienting experiments, phosphorus

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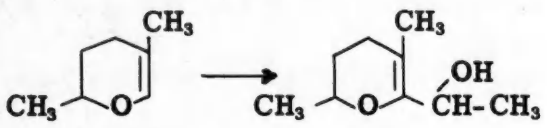
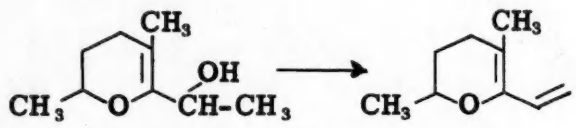
oxychloride-collidine is the reagent chosen to effect the transformation of (vi) to (ii). A discussion is recorded

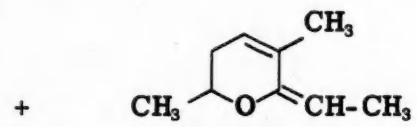


(v) (vi)

from which it is concluded that the formation of (ii) and (vii) are to be expected from the action of phosphorus oxychloride-collidine on (vi).



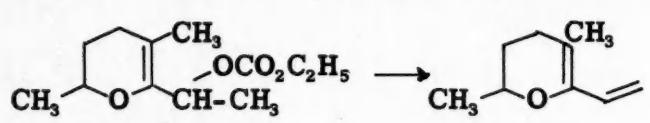
(vi) (ii)



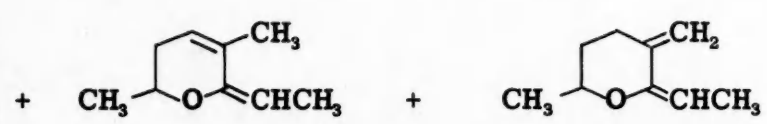
(vii)

The product resulting from the above reaction, Diene I, is shown to react (at 40°) with benzoquinone affording adduct A. The properties of the latter are shown to be compatible with those of a compound of structure (iii). No evidence is found to indicate that epimerization of the bridgehead hydrogen atoms of adduct A occurred, but neither is this possibility excluded. Structure (iii) for adduct A is shown to be in doubt to that extent.

A second preparation of (ii), Diene II, by pyrolysis of the ethyl carbonate ester, (viii), of (vi) is described.

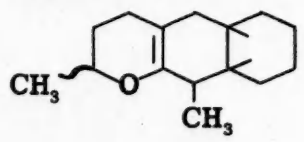


(viii) (ii)



(vii) (ix)

The presence of (ix) in this product is inferred from evidence based upon the infra-red spectrum of Diene II and from the fact that the latter reacts exothermally with benzoquinone affording adduct B, isomeric with adduct A. Structure (x) is assigned to adduct B.



(x)

The diene recovered from the preparation of adduct B, Diene III, is shown to be virtually identical with Diene I. However, the former is shown not to react with benzoquinone under conditions from which adduct A is obtained from the latter. It is established that the reaction between Diene I and benzoquinone is successful because an acid catalyst, presumably hydrogen chloride, is adventitiously present. It is demonstrated that Diene III will also react with benzoquinone to afford adduct A if chloroacetic acid is added to the reaction mixture. The practical consequences of this pronounced catalytic effect are discussed.

Diene I and Diene III are shown to be a mixture of (ii) and (vii).

A mechanism for the pyrolytic decomposition of (viii) is proposed. In it the C5 methyl group of (viii) participates as part of a cyclic transition state. In addition evidence is presented to show that another possible mechanism for the pyrolysis is not involved.

Several steps in the conversions of adducts A and B into known compounds are recorded, although the structure of neither adduct is unambiguously demonstrated in this manner. However, the available evidence makes it virtually certain that structure (iii) must be assigned to adduct A and that structure (x) must be assigned to adduct B.

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(2) E. C. Du Feu, J. J. McQuillin and R. Robinson, J. Chem. Soc., 1937, 53.

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172 pages. $2.15. Mic 56-1358

A STUDY OF REACTIONS OF VINYL KETONES WITH DIHYDRORESORCINOL AND Δ^{4a-8a}-OCTALIN-1,6-DIONE RELATED TO STEROID TOTAL SYNTHESIS

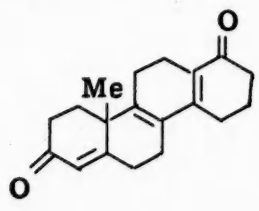
(Publication No. 16,142)

Walter Rowley Benn, Ph.D.
The University of Wisconsin, 1956

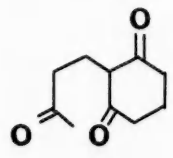
Supervisor: Professor A. L. Wilds

The original goal was to prepare the diketone intermediate I, which might be related to compounds synthesized by W. S. Johnson and coworkers (J. Am. Chem. Soc., 75, 2275 (1953)) and converted into non-aromatic steroids. While this goal has not been realized, one step in the proposed synthesis having taken a course other than that expected, the synthesis has led to interesting structures.

Methyl vinyl ketone was condensed with dihydroresorcinol in the presence of triethylamine to give the triketone II in good yield, together with lesser amounts of the dialkylation compound III.



I



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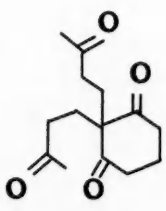
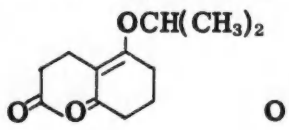


III

The triketone was transformed into its isopropyl enol ether IV and cyclized by means of sodium methoxide to the bicyclic enol ether V. By cleavage, the latter gave the bicyclic diketone VI in excellent yield, a compound which forms the rings C and D of the proposed D-homosteroid I.



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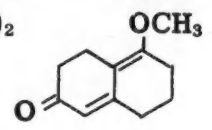

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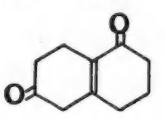

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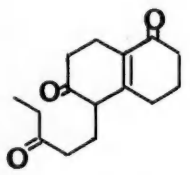

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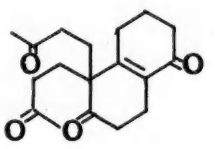
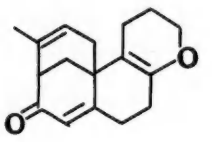


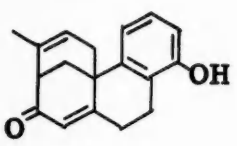
VIII



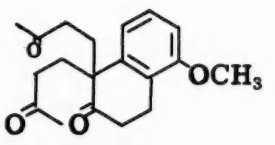
IX

The Michael condensation of vinyl ketones with the bicyclic diketone VI was studied extensively under a variety of conditions. Isolation of the mono-addition product VII proved very difficult, and it has not yet been obtained in a pure state. Products resulting from the addition of two vinyl ketone residues were isolated in crystalline form. Efforts have been made to establish the structure (probably VIII) for the tetraketone obtained by the reaction of methyl vinyl ketone with VI. Thus, VIII has been treated with various cyclodehydration reagents which have effected stepwise cyclization and dehydration with the ultimate formation of the tetracyclic diketone (probably IX). The structures for the compounds VIII and IX as well as the intermediate cyclodehydration compounds are consistent with theoretical as well as chemical and spectral evidence.

The proposed route for chemical proof of structure, as yet incomplete, is the following. Aromatization of IX has given a crystalline phenolic ketone believed to have structure X. It should be possible to arrive at the methyl ether of this compound by an independent synthesis from the reaction of 5-methoxy-2-tetralone XI with methyl vinyl ketone, the expected intermediate being the dialkylated compound XII.



X



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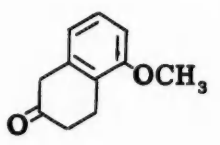
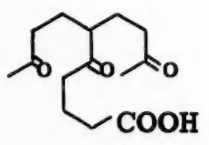


XI



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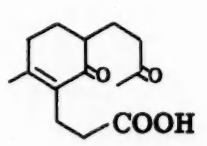
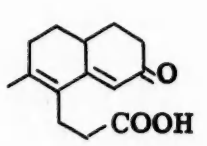


XIV



XV

The dialkylation product III obtained in the first step of the synthesis as a difficulty separable impurity was found to undergo an interesting transformation when carried along through the first three steps of the synthesis. Under the influence of the strong base employed in the cyclization of the enol ether IV, this impurity underwent hydrolytic cleavage to a carboxylic acid XIII and subsequent recyclization to the acid XIV and finally to XV. This last acid was separated from the desired bicyclic enol ether V by alkaline extraction.

It has been concluded that the failure to obtain the desired mono-adduct VII does not necessarily indicate the absence of this compound in the complex reaction mixture, but rather, reflects the sensitivity of this compound under standard isolation techniques such as alkaline extraction, distillation and chromatography. The structural similarity of this compound with the bicyclic diketone V and its 5-methyl analogue also isolated in this laboratory (A. L. Wilds, J. W. Ralls, W. C. Wildman, and K. E. McCaleb, J. Am. Chem. Soc., 72, 5794 (1950)), both of which are known to be quite unstable, strongly supports this contention.

182 pages. $2.28. Mic 56-1359

I. REDUCTION AND CLEAVAGE OF METHOXYL GROUPS IN THE REACTIONS OF LITHIUM AMIDES WITH BROMOANISOLES. II. THE ELECTRICAL EFFECTS OF THE TRIPHENYLSILYL GROUP.

(Publication No. 16,459)

Charles Edwin DeBoer, Ph.D.
Purdue University, 1956

Major Professor: Dr. Robert A. Benkeser

I. Reduction and Cleavage of Methoxyl Groups in the Reactions of Lithium Amides with Bromoanisoles:

The formation of anisole from the reactions of various lithium dialkylamides with o-bromoanisole was investigated. It was established that the dialkylamide ion was oxidized as the aryl halide was reduced. Lithium benzylmethylamide was oxidized to 2,5-diphenylpyrazine; lithium dibenzylamide to 2,3,5,6-tetraphenylpyrazine; and lithium bis-(p-methoxybenzyl)-amide to 2,3,5,6-tetra-(p-methoxyphenyl)-pyrazine.

That the initial oxidation product might be an imine was demonstrated when lithium benzylmethylamide reacted with N-benzilidinemethylamine to give 2,5-diphenylpyrazine. Also, lithium dibenzylamide when treated with N-benzilidinebenzylamine gave 2,3,5,6-tetraphenylpyrazine.

The reactions of three of the isomeric methyl-o-bromoanisoles with lithium dimethylamide in ether demonstrated that in this system, like the sodium amide-ammonia system, the dimethylamino group can enter only in the position adjacent to the displaced bromine atom.

When 2-bromo-3-methylanisole was reacted with lithium dimethylamide in ether, the product obtained was 2-bromo-3-methyldimethylaniline. Similar displacements of methoxyl groups were observed when anisole gave low yields of dimethylaniline and o-bromoanisole gave low yields of N,N,N′,N′-tetramethyl-m-phenylenediamine when treated with lithium dimethylamide in ether.

II. The Electrical Effects of the Triphenylsilyl Group:

The preparation of the isomeric meta and para triphenylsilylbenzoic acids and hydroxyphenyltriphenylsilanes is reported. The rates of reaction of the acids with diphenyldiazomethane and the sodium salts of the phenols with ethyl iodide were determined. From the rate data the values of σ_m, σ_p and σ_p^* for the triphenylsilyl group were calculated. These indicate that the triphenylsilyl group functions principally through a -I effect, and is capable of resonance interaction involving an expansion of the silicon valence shell to ten electrons when substituted para to the oxide ion.

155 pages. $1.94. Mic 56-1360

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I. A ROUTE TO 2,3-DISUBSTITUTED NAPHTHALENES. II. RESTRICTED ROTATION IN THE AMINOCOLLIDINE SERIES.

(Publication No. 16,390)

Joseph Edward Dunbar, Ph.D.
University of Illinois, 1956

Part I

A synthetic route to 2,3-disubstituted naphthalenes has been established by the employment of addition reactions of 2-methyl-2-acetoxy-1-p-toluenesulfonimido-1,2-dihydronaphthalene (I) after attempts to synthesize 2,3-disubstituted naphthalenes from N,N′-bis(dimethylsulfamyl)-1,4-naphthoquinone diimines failed.

Lead tetraacetate oxidation of 2-methyl-1-p-toluenesulfonamidonaphthalene (II) gave I together with an incidental amount of 2-methyl-1,4-naphthoquinone-1-p-toluenesulfonimide as a by-product. Hydrogen chloride, hydrogen bromide, acetic acid and methylmagnesium iodide added to I with simultaneous elimination of acetic acid to give 2-methyl-3-chloro-1-p-toluenesulfonamidonaphthalene (III), 2-methyl-3-bromo-1-p-toluenesulfonamidonaphthalene, 2-methyl-3-acetoxy-1-p-toluenesulfonamidonaphthalene and 1,2,4-trimethylnaphthalene, respectively. Hydrolysis of III in cold, concentrated sulfuric acid gave 2-methyl-3-chloro-1-naphthylamine (IV), which was deaminated to 2-methyl-3-chloronaphthalene. The chlorine atom was shown to occupy the 3-position by hydrogen peroxide oxidation of IV which yielded 2-methyl-3-chloro-1,4-naphthoquinone.

Hydrogen cyanide added to I to give an adduct presumed to be 2-methyl-2-acetoxy-1-cyano-1-p-toluenesulfonamido-1,2-dihydronaphthalene (V). Treatment of V with aqueous alkali resulted in the formation of II. Treatment of V with cold, concentrated sulfuric acid gave 2-methyl-x-cyano-x′-naphthylamine.

Mercaptoethanol and thiophenol each reduced I to the amide II. Acetylacetone, morpholine, phenol and benzenesulfinic acid did not react with I. Attempted addition of hydrogen fluoride to I in glacial acetic acid resulted in the formation of 2-methyl-3-hydroxy-1-p-toluenesulfonamidonaphthalene.

The original route, which was to lead to the synthesis of a variety of 2,3-disubstituted naphthalenes, involved the preparation of 2,3-disubstituted 1,4-bis(dimethylsulfamamido)-naphthalenes from N,N′-bis(dimethylsulfamyl)-1,4-naphthoquinone diimine. Hydrolysis of the 2,3-disubstituted diamides would give the 2,3-disubstituted 1,4-diaminonaphthalenes. Tetrazotization and deamination of the latter was to result in the formation of 2,3-disubstituted naphthalenes.

1,4-Bis(dimethylsulfamamido)-naphthalene (VI) was prepared by the bromination of 5,8-dihydro-1,4-bis(dimethylsulfamamido)-naphthalene (VII) followed by the dehydrobromination of the resulting 6,7-dibromo-5,8-dihydro-1,4-bis(dimethylsulfamamido)-naphthalene with ethanolic potassium hydroxide after an attempt to oxidize VII to VI with air in alkaline solution failed.

N,N′-Bis(dimethylsulfamyl)-1,4-naphthoquinone diimine (VIII) was prepared by the lead tetraacetate oxidation of VI. Hydrogen chloride added to VIII to give 2-chloro-1,4-bis(dimethylsulfamamido)-naphthalene (IX). IX was also prepared by the Diels-Alder addition of 1,3-butadiene to 2-chloro-N,N′-bis(dimethylsulfamyl)-p-benzoquinone diimine followed by bromination of the resulting 2-chloro-5,8-dihydro-1,4-bis(dimethylsulfamamido)-naphthalene (X) and dehydrobromination of X. Lead tetraacetate oxidation of IX gave 2-chloro-N,N′-bis(dimethylsulfamyl)-1,4-naphthoquinone diimine which added hydrogen chloride to give 2,3-dichloro-1,4-bis(dimethylsulfamamido)-naphthalene (XI). XI was hydrolyzed to 2,3-dichloro-1,4-diaminonaphthalene (XII) in cold, concentrated sulfuric acid. Attempts to deaminate XII resulted in the formation of 2,3-dichloro-1,4-naphthoquinone.

Part II

N-Benzenesulfonyl-N-carboxymethyl-3-amino-2,4,6-trimethylpyridine (I) was prepared from 3-amino-s-collidine (II). II was benzenesulfonated to give N,N-dibenzenesulfonyl-3-amino-2,4,6-trimethylpyridine, which was converted to N-benzenesulfonyl-3-amino-2,4,6-trimethylpyridine (III) by treatment with sodium ethoxide. III was alkylated with methyl bromoacetate to give N-benzenesulfonyl-N-carbomethoxymethyl-3-amino-2,4,6-trimethylpyridine which was hydrolyzed to I. Attempts to resolve I into its enantiomorphic forms failed.

N,N-Dibenzenesulfonyl-3-amino-2,4,6-trimethylpyridine 1-oxide, N-benzenesulfonyl-3-amino-2,4,6-trimethylpyridine 1-oxide and N-benzenesulfonyl-N-carboxymethyl-3-amino-2,4,6-trimethylpyridine 1-oxide (IV) were prepared by oxidation of the corresponding collidines with 30 per cent hydrogen peroxide in glacial acetic acid. Attempts to resolve IV into its enantiomorphic forms failed.

133 pages. $1.66. Mic 56-1361

DERIVATIVES OF PIPERAZINE. XVI. THE ADDITION OF 1-ARYLPIPERAZINES TO 1,2-EPOXY-3-ARYLOXYPROPANES.

(Publication No. 16,365)

Jaime B. Fernandez, Ph.D.
The University of Florida, 1956

Fifty-six new 1-aryl-4-(2-hydroxy-3-aryloxypropyl)-piperazines have been prepared by the addition of 1-arylpiperazines to 1,2-epoxy-3-aryloxypropanes. The previously unreported 1,2-epoxy-3-(4-methoxyphenoxy)propane has also been prepared.

A review of the essential literature has been presented. The general methods by which the compounds were prepared and purified are listed.

An individual sheet, which tabulates significant data, has been included for each compound prepared.

93 pages. $1.16. Mic 56-1362

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REACTIONS OF VINYL HALIDES WITH BUTYLLITHIUM

(Publication No. 16,393)

Edmund William Flynn, Ph.D.
University of Illinois, 1956

cis- and trans-β-Bromostyrene labeled in the α-position with C^{14} were allowed to react with butyllithium and after carbonation afforded phenylpropiolic acid-C^{14} as the only acid product from each isomer. Oxidation of the C^{14}-phenylpropiolic acids gave benzoic acid-7-C^{14} containing 100% of the radioactivity, within experimental error, present in the original cis- or trans-β-bromostyrene. There is, therefore no rearrangement of the carbon skeleton in this reaction.

β-Methyl-β-bromostyrene was allowed to react with butyllithium and after carbonation starting material was recovered to the extent of 80%. α-Methyl-β-bromostyrene was allowed to react with butyllithium in the same manner and after carbonation, in addition to some 30-50% of recovered starting material, there was evidence for the possible formation of α-methylstyrene. In neither case was there any evidence for the formation of the dehydrohalogenation product, methylphenylacetylene.

Diphenylvinyl bromide was allowed to react with butyllithium and after carbonation afforded a mixture of β-phenylcinnamic acid (30%), tolan (43%) and butyl diphenylvinyl ketone (6%). Diphenyl vinyl iodide was allowed to react with butyllithium in the same manner and after carbonation gave phenylcinnamic acid (66%), tolan (13%) and butyl diphenylvinyl ketone 10%). Under the same conditions, diphenylvinyl chloride was recovered to the extent of 82%. However, if the reaction were allowed to proceed for a longer time before being carbonated tolan was produced in 34% yield with 54% of the diphenylvinyl chloride being recovered.

cis- and trans- 1-Phenyl,1-p-chlorophenyl-2-bromoethylene-1-C^{14} were allowed to react with butyllithium and after carbonation, in addition to the diaryl acrylic acids afforded p-chlorotolan-C^{14}. Oxidative degradation of the p-chlorotolans and radioactive assay of the benzoic and p-chlorobenzoic acids thus obtained, indicated that the group trans to the leaving bromide ion migrates preferentially in the case of each isomer. Thus the symmetrically solvated carbene is excluded as a distinct intermediate in the rearrangement reaction.

1,1-Diphenyl-2,2-dibromoethylene was allowed to react with butyllithium at -35° for thirty seconds and after hydrolysis afforded 80% of tolan and 13% of recovered starting material.

The mechanism of the tolan-forming reaction is discussed. 143 pages. $1.79. Mic 56-1363

EVIDENCE OF THE PRESENCE OF A TOXIC METABOLITE OF ALDRIN IN CARROT PLANT MATERIAL

(Publication No. 15,995)

Ralph Frederick Glasser, Ph.D.
Cornell University, 1956

The results of the quantitative determination of residues in carrot plant material grown on soil treated with aldrin caused concern since microbioassay of the macerated crop, a method based on toxicity to D. melanogaster, indicated residues greater than those obtained by the chemical methods, aldrin specific phenyl azide and semi-specific total chloride. Evidence of the presence of a toxic metabolite of aldrin in carrot plant material has been suggested as a partial answer to this problem.

This study was conducted in order to exclude external factors, rigorously test the methods of analysis; and if the methods indicated the presence of a metabolite, an attempt was to be made to isolate and identify this transformation product.

Two carrot samples were used in this study. One sample received a four pound per acre furrow-drench application of a formulation containing 99.3 per cent aldrin in xylene with Triton X-100 used as an emulsifying agent. The other sample received a twelve pound per acre soil treatment of an aldrin 25 per cent wettable powder formulation containing a minimum of 97.4 per cent aldrin.

The external factors as herein considered were excluded as contributing to the variance of the residue results since:

1. the holdover of toxic materials in the soil could be discounted, neither plot having received insecticidal applications prior to this experiment.
2. randomization of untreated and treated samples in the plots and in the laboratory pre-analytical preparation would make both equally susceptible to contamination. The microbioassay of the untreated crop showed negligible residue.
3. the presence of toxic material other than aldrin in the formulations was unlikely, the aldrin used in both being of high purity.

The methods of analysis have been described in detail. The use of plant extract and chromatographed extract, necessary for the chemical methods, was introduced in the microbioassay. The methods of analysis experiment was statistically designed to compare:

1. the methods of analysis
   (a) microbioassay of macerated crop (I) versus microbioassay of extracts (II) together with chemical methods (III).
   (b) method (II) versus method (III).
2. the efficiency of two crop extraction procedures
   (a) Skellysolve B alone (S) versus Skellysolve B-Isopropanol (SI) - method (II).
   (b) (S) versus (SI) - method (III).
3. the use of extracts versus chromatographed extracts - method (II).

The Snedecor test of a mean difference ("t" test) was applied to (1), the methods of analysis data. Highly significant "t" values were obtained on comparison of (I) with (II) and (III), and (II) with (III). To evaluate (2) and (3) Snedecor's analysis of variance was used. Highly significant mean squares obtained for (2) suggest that the use of

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Skellysolve B-Isopropanol for crop extraction was superior to Skellysolve B alone. Highly significant mean squares obtained for (3) indicate that the Attasol-SuperCel chromatographic column had removed some toxic material in the adsorbent process.

The toxic material suspected was dieldrin, the epoxide derivative of aldrin. Preliminary experiments indicated that:

1. dieldrin added to check carrot extract and passed through a magnesium oxide celite column would occur in the third 100 ml. fraction.
2. recovery of dieldrin would be 61-84 per cent, depending on the method of analysis.
3. the interference of aldrin with the reduction-phenyl azide method, specific for dieldrin would be negligible.

Apparent aldrin and dieldrin were detected in the first and third 100 ml. chromatographed extract fractions respectively. On summation, the results, expressed as total toxicant, approximated those obtained by microbioassay of the macerated crop, expressed as aldrin.

The general conclusion is that:

1. external factors do not contribute to the variance.
2. incomplete extraction could account in part for some variance.
3. a toxic material has been isolated and accounts for the variance in aldrin residue determinations.
4. on the presumption that the reduction-phenyl azide method is conclusive evidence that the toxic material detected is dieldrin, aldrin has been partially converted to dieldrin in either the soil or carrot tissue.

80 pages. $1.00. Mic 56-1364

THE EFFECT OF META SUBSTITUTION ON THE STABILITY OF OPTICALLY ACTIVE MESIDINES

(Publication No. 16,396)

Melvin Jerome Gortatowski, Ph.D.
University of Illinois, 1956

Early investigations of restricted rotation in aryl amines have led to the proposal that, in general, electron-withdrawing groups in the ortho or para positions tend to decrease the half-life (increase the racemization rate) by virtue of resonance interaction, whereas electron-releasing groups exert the opposite effect. Although groups in the meta position cannot exert such an influence through resonance, it is possible that either the inductive effect or the "buttressing effect" or both would be manifested in the optical stability of such molecules.

In the present study, a series of N-benzenesulfonyl-N-carboxymethyl-3-substituted mesidines has been prepared, a number of them resolved and the racemization rates determined at 118°. The average half-lives as derived from the racemization rates are as follows: 3-nitro, one and seven-tenths hours; 3-chloro, six and nine-tenths hours; 3-bromo, seven and six-tenths hours; 3-iodo, seven and two-tenths hours; 3-benzenesulfonamido (dextrorotatory isomer), seven and nine-tenths hours and (levorotatory isomer), three and three-tenths hours; 3-amino, seven hours.

Since the half-lives within this series are of the same order of magnitude (within experimental error), with the exception of the 3-nitro compound and the levorotatory isomer of the 3-benzenesulfonamido compound, it appears that a substituent in the 3-position has only a slight effect on the optical stability of the molecules under investigation.

The resolution of the 3-fluoro acid either by means of its cinchonine salt or cinchonidine salt was not successful; the cinchonidine salt exhibited no mutarotation. The 3-acetamido and the 3-benzamido acids were prepared, but crystalline alkaloid salts were formed only with difficulty; therefore resolution was not effected.

The lower value for the half-life of the 3-nitro compound as compared with the other compounds in the series was explained on the basis of a decreased restriction of rotation because of the possible interaction of the methyl and nitro groups through hydrogen bonding.

The difference in the half-lives of the levorotatory and dextrorotatory isomers of the 3-benzenesulfonamido acid was accounted for by the possible existence of two centers of restricted rotation in the molecule, the lower value (three and three-tenths hours) being attributed to restriction about the carbon-secondary nitrogen bond and the higher value (seven and nine-tenths hours) to restriction about the carbon-tertiary nitrogen bond.

The nitro, fluoro, chloro, bromo and iodo acids employed in this study were prepared from the corresponding 3-substituted mesidines by benzenesulfonation of the amines, alkylation of the benzenesulfonamides with methyl bromoacetate and subsequent hydrolysis of the esters to the corresponding N-benzenesulfonyl-N-carboxymethyl-3-substituted mesidines. The 3-acetamido, 3-benzamido and 3-benzenesulfonamido acids were prepared by acylation of N-benzenesulfonyl-N-carbomethoxymethyl-3-aminomesidine followed by alkaline cleavage of the esters. The optically active 3-amino acid was obtained by reduction of the optically active 3-nitro acid with sodium hydrosulfite.

103 pages. $1.29. Mic 56-1365

THE EFFECT OF RING SIZE ON THE RATE OF ACETOLYSIS OF THE CYCLOALKYL p-TOLUENESULFONATES

(Publication No. 16,468)

George Edward Ham, Ph.D.
Purdue University, 1956

Major Professor: Herbert C. Brown

The p-toluenesulfonates of the cyclanols containing four through seventeen ring atoms, excluding cyclodecyl and cyclohexadecyl, were prepared and the first order rate constants of acetolysis measured at three different temperatures in a solvent containing 0.046 moles per liter of acetic anhydride. The enthalpies and entropies of activation were calculated. The rate constants, enthalpies and entropies of activation are as follows: cyclopentyl p-toluenesulfonate, k_1 is 3.23×10^{-6} sec.$^{-1}$ at 30°, 3.82×10^{-5} sec.$^{-1}$ at 50° and 3.32×10^{-4} sec.$^{-1}$ at 70°; $\triangle H^{\ddagger}$ is 24.1 kcal/mole, $\triangle S^{\ddagger}$ is -4.2 e.u.; cyclohexyl p-toluenesulfonate, k_1 is 1.82×10^{-6} sec.$^{-1}$ at 50°, 2.37×10^{-5} sec.$^{-1}$ at 70° and 2.22×10^{-4} sec.$^{-1}$ at 90°; $\triangle H^{\ddagger}$ is 27.3 kcal/mole and $\triangle S^{\ddagger}$ is -0.5 e.u.; cycloheptyl p-toluenesulfonate, k_1 is

6.45×10^{-5} sec.$^{-1}$ at 50°, 6.00×10^{-4} sec.$^{-1}$ at 70° and 3.95×10^{-3} sec.$^{-1}$ at 90°; $\triangle H^{\ddagger}$ is 23.3 kcal/mole and $\triangle S^{\ddagger}$ is -5.7 e.u.; cyclooctyl p-toluenesulfonate, k_1 is 2.82×10^{-5} sec.$^{-1}$ at 25°, 5.68×10^{-4} sec.$^{-1}$ at 50° and 4.52×10^{-3} sec.$^{-1}$ at 70°; $\triangle H^{\ddagger}$ is 22.3 kcal/mole and $\triangle S^{\ddagger}$ is -4.5 e.u.; cyclononyl p-toluenesulfonate, k_1 is 2.43×10^{-5} sec.$^{-1}$ at 25°, 8.72×10^{-5} sec.$^{-1}$ at 35° and 4.08×10^{-3} sec.$^{-1}$ at 70°; $\triangle H^{\ddagger}$ is 22.5 kcal/mole and $\triangle S^{\ddagger}$ is -4.2 e.u.; cycloundecyl p-toluenesulfonate, k_1 is 2.02×10^{-5} sec.$^{-1}$ at 35°, 1.29×10^{-4} sec.$^{-1}$ at 50° and 1.16×10^{-3} sec.$^{-1}$ at 70°; $\triangle H^{\ddagger}$ is 23.7 kcal/mole and $\triangle S^{\ddagger}$ is -3.2 e.u.; cyclododecyl p-toluenesulfonate, k_1 is 5.97×10^{-6} sec.$^{-1}$ at 50°, 7.70×10^{-5} sec.$^{-1}$ at 70° and 7.63×10^{-4} sec.$^{-1}$ at 90°; $\triangle H^{\ddagger}$ is 27.6 kcal/mole and $\triangle S^{\ddagger}$ is 2.8 e.u.; cyclotridecyl p-toluenesulfonate, k_1 is 7.27×10^{-6} sec.$^{-1}$ at 50°, 8.30×10^{-5} sec.$^{-1}$ at 70° and 7.25×10^{-4} sec.$^{-1}$ at 90°; $\triangle H^{\ddagger}$ is 26.2 kcal/mole and $\triangle S^{\ddagger}$ is -1.3 e.u.; cyclotetradecyl p-toluenesulfonate, k_1 is 2.47×10^{-6} sec.$^{-1}$ at 50°, 3.12×10^{-5} sec.$^{-1}$ at 70° and 3.28×10^{-4} sec.$^{-1}$ at 90°; $\triangle H^{\ddagger}$ is 27.8 kcal/mole and $\triangle S^{\ddagger}$ is 1.7 e.u.; cyclopentadecyl p-toluenesulfonate, k_1 is 4.30×10^{-6} sec.$^{-1}$ at 50°, 5.18×10^{-5} sec.$^{-1}$ at 70° and 4.53×10^{-4} sec.$^{-1}$ at 90°; $\triangle H^{\ddagger}$ is 26.5 kcal/mole and $\triangle S^{\ddagger}$ is -1.3 e.u.; cycloheptadecyl p-toluenesulfonate, k_1 is 4.38×10^{-6} sec.$^{-1}$ at 50°, 5.15×10^{-5} sec.$^{-1}$ at 70° and 4.60×10^{-4} sec.$^{-1}$ at 90°; $\triangle H^{\ddagger}$ is 26.5 kcal/mole and $\triangle S^{\ddagger}$ is -1.4 e.u.

The p-bromobenzenesulfonates of cyclopentanol, cyclohexanol and cycloheptanol were prepared and the rates of acetolysis measured in the same solvent at three different temperatures. The rate constants, enthalpies and entropies of activation are as follows: cyclopentyl p-bromobenzenesulfonate, k_1 is 6.28×10^{-6} sec.$^{-1}$ at 25°, 1.29×10^{-4} sec.$^{-1}$ at 50° and 1.10×10^{-3} sec.$^{-1}$ at 70°; $\triangle H^{\ddagger}$ is 22.7 kcal/mole and $\triangle S^{\ddagger}$ is -6.3 e.u.; cyclohexyl p-bromobenzenesulfonate, k_1 is 6.60×10^{-6} sec.$^{-1}$ at 50°, 8.02×10^{-5} sec.$^{-1}$ at 70° and 7.28×10^{-4} sec.$^{-1}$ at 90°; $\triangle H^{\ddagger}$ is 26.8 kcal/mole and $\triangle S^{\ddagger}$ is 0.4 e.u.; cycloheptyl p-bromobenzenesulfonate, k_1 is 1.04×10^{-5} sec.$^{-1}$ at 25°, 2.23×10^{-4} sec.$^{-1}$ at 50°, 6.70×10^{-4} sec.$^{-1}$ at 60° and 1.98×10^{-3} sec.$^{-1}$ at 70°; $\triangle H^{\ddagger}$ is 23.0 kcal/mole and $\triangle S^{\ddagger}$ is -4.2 e.u.

200 pages. $2.50. Mic 56-1366

A STUDY OF THE RING-CLEAVAGE REACTIONS OF FLUORINE-CONTAINING EPOXIDES (PARTS I-V)

(Publication No. 16,471)

Clayton Edward Hathaway, Jr., Ph.D.
Purdue University, 1956

Major Professors: E. T. McBee and C. W. Roberts

Part I

The reactions of 1,1,1-trifluoro-2,3-epoxypropane with ethanol, lithium aluminum hydride, ammonia, diethylamine, magnesium bromide, methyl magnesium bromide and hydrogen bromide gave respectively 3-ethoxy-1,1,1-trifluoro-2-propanol, 1,1,1-trifluoro-2-propanol, 3-amino-1,1,1-trifluoro-2-propanol, 3-diethylamino-1,1,1-trifluoro-2-propanol and 3-bromo-1,1,1-trifluoro-2-propanol. A hypothesis is presented which explains the exclusive cleavage of the terminal carbon-oxygen bond in terms of the relative transition state energies for reaction at the two possible reaction sites. The relative significance of this and other electronic and steric factors are evaluated as part of the general theory for epoxide ring-cleavage reactions. The isomeric hydroxyether, 2-ethoxy-3,3,3-trifluoro-1-propanol, was prepared by the diazotization of 2-ethoxy-3,3,3-trifluoro-1-propanamine.

Part II

The reaction of 1,1,1-trifluoro-2,3-epoxybutane and 2-methyl-1,1,1-trifluoro-2,3-epoxypropane with ethanol gave respectively 3-ethoxy-1,1,1-trifluoro-2-butanol and 3-ethoxy-2-methyl-1,1,1-trifluoro-2-propanol under both basic and acidic conditions. The product from the first reaction is a function only of electronic factors independent of steric complications and that from the second of the relative directive abilities of the methyl and trifluoromethyl in orienting the cleavage process. The significance of the orientation observed is discussed in terms of the hypothesis discussed in Part I.

Part III

The attempted preparation of 2-methyl-1,1,1-trifluoro-2,3-epoxypropane by reaction of 2-methyl-3,3,3-trifluoropropene with peroxytrifluoroacetic acid or hypochlorous acid was unsuccessful though a small amount of chlorohydrin was obtained in the second case. The pyrolysis of the quaternary hydroxide of 3-amino-1,1,1-trifluoro-2-butanol gave no 1,1,1-trifluoro-2,3-epoxybutane.

Part IV

The pyrolysis of a mixture of propionic and trifluoroacetic acid over thorium oxide or the thermal decomposition of a mixture of their calcium did not yield 1,1,1-trifluoro-2-butanone.

Part V

pK_a values have been determined for 3-amino-1,1,1-trifluoro-2-propanol and 3-diethylamino-1,1,1-trifluoro-2-propanol in aqueous solution and are found to be less than that for ethanol. The relative values of these two are consistent with the predicted effect of the substituents on the amino group. An inflection point was obtained in the titration of trifluoroethanol in strongly basic medium which approximated closely the theoretical equivalence point.

183 pages. $2.29. Mic 56-1367

I. COPOLYMERIZATION REACTIONS OF ACONITIC ACID AND ITS DERIVATIVES. II. COPOLYMERIZATION REACTIONS OF SUBSTITUTED ANTHRACENES.

(Publication No. 16,403)

John Webster Johnson, Jr., Ph.D.
University of Illinois, 1956

I. Reactivity ratios for the copolymerization of trimethyl aconitate (M_2) with butadiene (M_1), styrene (M_1),

acrylonitrile (M_1) and vinyl chloride (M_1) have been determined at 60°C. In each case the reactivity ratio for trimethyl aconitate, r_2, was found to be zero within experimental error. The values of the reactivity ratios for the comonomers were found to be: butadiene, $r_1 = 0.40 \pm 0.03$; styrene, $r_1 = 1.10 \pm 0.10$; acrylonitrile, $r_1 = 5.50 \pm 0.50$; and vinyl chloride, $r_1 = 0.15 \pm 0.10$. For comparison the reactivity ratios for the copolymerization of triethyl aconitate (M_2) with butadiene (M_1) and styrene (M_1) were determined. The reactivity ratio, r_2, was found to be zero within experimental error. The reactivity ratios for the comonomers were found to be: butadiene, $r_1 = 0.37 \pm 0.03$; and styrene, $r_1 = 1.10 \pm 0.10$.

A copolymer of butadiene and trimethyl aconitate has been evaluated for use as a rubber. The copolymer contained 25 per cent of combined trimethyl aconitate. The evaluation tests indicated that the copolymer had fair oil resistance, good tensile properties, fair temperature-rise properties but poor low temperature properties.

No evidence could be obtained for the homopolymerization or the copolymerization of aconitic acid in acid-side recipes using free radical initiation. Aconitic acid does not inhibit the free radical polymerization of butadiene, methyl acrylate, acrylonitrile or vinyl acetate.

II. 2-Chloroanthracene has been copolymerized with butadiene in water emulsion with benzene as the mutual solvent for the monomers. A large sample of the copolymer has been prepared and evaluated as a rubber. The results indicated that the copolymer had very good temperature-rise properties in a tread type recipe. In a carcass type recipe the temperature-rise properties are similar to those of standard GR-S copolymers. The low temperature properties of this copolymer are good but the stress-strain properties and oil resistance are inferior to the control.

2-Chloro-9,10-dihydroanthracene has been prepared from 2-chloroanthracene by catalytic hydrogenation and its ultraviolet absorption spectrum has been recorded. The similarity of the ultraviolet absorption spectra of 2-chloro-9,10-dihydroanthracene and copolymers of butadiene with 2-chloroanthracene supports the conclusion that incorporation of anthracene and its derivatives in copolymers occurs by free radical attack at the meso-positions.

The copolymerization of butadiene with 1-chloroanthracene has been studied. It has been found that this anthracene derivative is incorporated to a larger extent than 2-chloroanthracene in emulsion systems with benzene as mutual solvent and more significantly in emulsion systems without the use of benzene. In butadiene-1-chloroanthracene copolymers 1-chloroanthracene is incorporated to the extent of (1) 16.9 per cent by weight when benzene is absent from the charge and (2) 21.2 per cent by weight when benzene is added to the charge. In butadiene-2-chloroanthracene copolymers, 2-chloroanthracene is incorporated to the extent of (1) 7.3 per cent by weight when benzene is absent from the charge and (2) 14.2 per cent when benzene is added to the charge. These comparisons are for 90/10 charging ratios: butadiene/substituted anthracene and 15 hours of polymerization at 50°C.

106 pages. $1.33. Mic 56-1368

STEREOCHEMISTRY OF SUBSTITUTED 9,10-DIAMINO-ANTHRACENES AND -PHENANTHRENES

(Publication No. 16,404)

Gordon Robert Johnston, Ph.D.
University of Illinois, 1956

Restriction of the normal rotation of the carbon-nitrogen single bond in organic amines has been the subject of numerous investigations. Such a limitation of free rotation has led to the isolation of stereoisomers of these compounds.

The effect of altering the normal bond angles by which the methyl groups ortho to the amine residue are attached to the ring in aminomesitylenes, diaminodurenes, and 1-aminonaphthalenes has been studied by extending the work of Adams and co-workers from the benzene and naphthalene series to the anthracene and phenanthrene series. This has been accomplished by an investigation of the stereochemistry of N,N′-dialkyl-N,N′-dibenzenesulfonyl -9,10-anthracenediamines and -9,10-phenanthrenediamines.

Anthracene-9,10-dibenzenesulfonamide and phenanthrene-9,10-dibenzenesulfonamide were alkylated with the appropriate alkyl halide in the presence of a basic catalyst to yield the corresponding dialkyl derivative. N,N′-Dimethyl-N,N′-dibenzenesulfonyl-9,10-anthracenediamine was prepared and separated into two geometric isomers, m.p. 314-315° (dec.) and m.p. 307-307.5° (dec.). The infrared spectrum (680-700 $cm.^{-1}$) of the higher melting isomer possesses two absorption maxima at 687 and 695 $cm.^{-1}$ and that of the lower melting isomer has one absorption maximum at 689 $cm.^{-1}$ N,N′-Dibenzyl-N,N′-dibenzenesulfonyl-9,10-anthracenediamine was prepared and separated into two geometric isomers, m.p. 259-260° (dec.) and 242.5-243.5° (dec.). The infrared spectrum (680-700 $cm.^{-1}$) of the higher melting isomer has one absorption maximum at 689 $cm.^{-1}$ and that of the lower melting isomer has two absorption maxima at 688 and 698 $cm.^{-1}$ Both isomers of N,N′-dimethyl-N,N′-dibenzenesulfonyl-9,10-anthracenediamine, upon prolonged heating, gave the same equilibrium mixture consisting of 55% of the higher melting isomer and 45% of the lower melting isomer. Similarly N,N′-dibenzyl-N,N′-dibenzenesulfonyl-9,10-anthracenediamine yielded a mixture containing 63% of the lower melting isomer and 37% of the higher melting isomer.

N,N′-Diethyl-N,N′-dibenzenesulfonyl-9,10-anthracenediamine was prepared and isolated in only one form, m.p. 335.5° (dec.). The reaction of anthracene-9,10-dibenzenesulfonamide with ethyl bromoacetate gave a mixture of products from which no pure compounds could be obtained.

Phenanthrene-9,10-dibenzenesulfonamide was prepared, m.p. 256.5-257°. Its structure was confirmed by ultraviolet analysis.

N,N′-Dimethyl-N,N′-dibenzenesulfonyl-9,10-phenanthrenediamine was prepared and isolated in only one form, m.p. 235-236.5°. The reaction of phenanthrene-9,10-dibenzenesulfonamide with ethyl iodide appeared to give some N,N′-diethyl-N,N′-dibenzenesulfonyl-9,10-phenanthrenediamine, m.p. 202-203°, but the major product was a mixture from which no pure compounds could be obtained. The reaction of phenanthrene-9,10-dibenzenesulfonamide with ethyl bromoacetate gave, as the major product, N-carbethoxymethyl-N,N′-dibenzenesulfonyl-9,10-phenanthrenediamine, m.p. 190-190.5°. The reaction of

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phenanthrene-9,10-dibenzenesulfonamide with benzyl chloride gave a small amount of N-benzyl-N,N′-dibenzenesulfonyl-9,10-phenanthrenediamine, m.p. 194-195°. The major product, however, was unreacted starting material.

82 pages. $1.03. Mic 56-1369

REACTIONS OF ALLOXAN WITH 4,5-DIAMINOPYRIMIDINES

(Publication No. 16,409)

Harvey Monroe Loux, Ph.D.
University of Illinois, 1956

The structure of Wieland's "bisalloxazine," which is formed by reaction of 5,6-diamino-2,4-dihydroxypyrimidine with alloxan, has been definitely shown to be 2,4,5,7-tetrahydroxypyrimido(5,4-g)pteridine.[1]

It has been shown that 4,5-diaminopyrimidines readily undergo oxidative self-condensations to form pyrimido-(5,4-g)pteridines and pyrimido(4,5-g)pteridines and that the extremely insoluble, highly fluorescent, and deeply colored by-products often obtained from reactions involving 4,5-diaminopyrimidines have these tricyclic structures. A mechanism for these condensations has been suggested.[2]

The compound obtained by ferricyanide oxidation of 5-amino-2,4-dihydroxypyrimidine has been shown to be 2,4,6,8-tetrahydroxypyrimido(4,5-g)pteridine rather than "diuracilpyridazine" as previously postulated. A brief investigation of the generality of this oxidative coupling has been undertaken and possible mechanisms have been discussed.[2]

The synthesis of 1-methyl-3-cyano-4-methoxy-6-pyridone, a previously unknown isomer of the alkaloid ricinine, has been carried out.[3]

Pteridine-6-carboxylic acids have been synthesized by reaction of 4,5-diaminopyrimidines with alloxan in alkaline medium. Extension of this reaction to 4-alkylamino-5-aminopyrimidines has resulted in an excellent preparative method for 8-alkyl-7-pteridone-6-carboxylic acids.[4] Reduction of the 7-carbonyl group of these 8-alkyl-7-pteridone-6-carboxylic acids to a methylene group has been carried out under Clemmenson conditions. This reduction was the last step in the synthesis of a series of compounds of possible biological interest, e.g. 2-amino-4-hydroxy-8-(D-1′-ribityl)-7,8-dihydropteridine-6-carboxylic acid. The carbonyl group may be reduced using lithium aluminum hydride in cases not limited by insolubility; however, this reagent was found to reduce also the 5,6 double bond and the carboxyl group.

The mechanisms by which alloxan reacts with 4,5-diaminopyrimidines and 4-alkylamino-5-aminopyrimidines under both acidic and alkaline conditions have been discussed. In alkaline medium alloxan most probably is cleaved to an open chain anion which reacts with the diaminopyrimidine to form a pteridine-6-carboxyureide which is then hydrolyzed to the pteridine-6-carboxylic acid; however, in acidic medium an anil forms which undergoes cyclization to a pyrimido(5,4-g)pteridine. The latter then may be degraded to a pteridine-6-carboxylic acid by alkali.

An unsuccessful attempt to prepare an 8-glucosyl pteridine by reaction of 2,4-diamino-8-chloromercuri-7,8-dihydropteridine with 2,3,4,6-tetraacetyl- -D-glucosyl bromide has been discussed and possible reasons for the failure have been suggested.

145 pages. $1.81. Mic 56-1370

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SUBSTITUTED LITHIUM ALUMINUM HYDRIDES. A NEW ALDEHYDE SYNTHESIS.

(Publication No. 16,479)

Richard F. McFarlin, Ph.D.
Purdue University, 1956

Major Professor: Herbert C. Brown

Aluminum methoxide in a pure, white form was obtained most conveniently by the use of spectroscopically pure aluminum. Two other routes to the pure methoxide were provided by the alcoholysis reactions between aluminum ethoxide and methanol or methyl borate.

Three unreported lithium aluminum tetraalkoxides, the tetraethoxide, tetraisopropoxide and tetra-t-butoxide, were prepared both from the reaction of the aluminum alkoxide with the appropriate lithium alkoxide and from the reaction of four equivalents of alcohol with etheric solutions of lithium aluminum hydride. It was necessary to react the lithium and aluminum t-butoxides at 80° as reaction did not occur at room temperature. The fourth hydrogen of lithium aluminum hydride was replaced by t-butyl alcohol also only at higher temperatures. The tetramethoxy compound was formed from the reaction of four moles of methanol with lithium aluminum hydride in addition to Meerwein's preparation from the lithium and aluminum methoxides. Lithium aluminum tetramethoxide and tetraethoxide were found to be very soluble in their respective alcohols while the tetraisopropoxide was sparingly soluble in isopropanol and no suitable solvent was found for the tetra-t-butoxide.

Lithium trialkoxyaluminohydrides were prepared by the action of exactly three equivalents of alcohol with one equivalent of lithium aluminum hydride in ether. Tertiary alcohols were found to replace only three of the hydrogens of lithium aluminum hydride at room temperature even when the tertiary alcohols were present in excess. This provided a convenient route to pure tri-t-alkoxyaluminohydrides. The failure of the reactions attempted between aluminum alkoxides and lithium and sodium hydrides is attributed to a combination of the polymeric nature of the alkoxides and the insolubility of the alkali metal hydrides. The trialkoxyaluminohydride systems appeared to be free from disproportionation.

Lithium tri-t-butoxyaluminohydride was found to exhibit a reducing behavior toward aldehydes, ketones, acid chlorides and acid anhydrides. This mild reducing action is tentatively attributed to the large steric requirements

of this molecule, as it appears that the less hindered trialkoxyaluminohydrides exert a more powerful reducing action. Lithium tri-t-butoxy- and tri-t-amyloxyaluminohydrides were found to reduce benzoyl chloride to benzaldehyde in significant yields, a reduction the other trialkoxyaluminohydrides did not effect.

The application of lithium tri-t-butoxy- and tri-t-amyloxyaluminohydrides in a general aldehyde synthesis from acid chlorides was studied.

The proper reaction conditions for maximum aldehyde yield were determined from a study of several reaction variables. Two solvents, the dimethyl ether of diethylene glycol and tetrahydrofuran, were found in which the reducing agents formed solutions of greater than one molar concentration and which appeared to be suitable for the aldehyde synthesis. The tri-t-butoxy compound in the dimethyl ether of diethylene glycol added to the acid chloride at approximately -70° effected the maximum aldehyde yields. Large scale reductions on p-nitrobenzoyl and benzoyl chlorides resulted in the isolation of 80 and 73% of the respective aldehydes. Several other smaller scale reductions were carried out in which the aldehyde yields were determined from the quantity of the 2,4-dinitrophenylhydrazone isolated. The selectivity of this reducing agent prevents a simultaneous attack on other centers such as esters, nitriles, nitro groups and carbon-carbon double bonds. While the full scope of this reaction remains to be investigated, lithium tri-t-butoxyaluminohydride as a reagent for the conversion of acid chlorides to aldehydes appears to be a promising new member of the complex hydrides.

218 pages. $2.73. Mic 56-1371

SYNTHESIS OF INDOLES AND COMPOUNDS RELATED TO TRYPTOPHAN

(Publication No. 16,414)

Edward Paul Merica, Ph.D.
University of Illinois, 1956

INTRODUCTION

6-Methyltryptophan and certain other 6-alkyltryptophans have been found to protect mice and monkeys against the Lansing poliomyelitis virus to some extent. Since tryptophans possessing electron-withdrawing groups have not been tested for their effect on the Lansing polio virus, the present work was undertaken to develop a method for the preparation of such compounds.

DISCUSSION

It was thought that the required 6-substituted indoles could be prepared by combining the alkylation of ethyl cyanoacetate by nitrochlorobenzenes, reported by Fairbourne and Fawson,[1] with the Stephen[2] synthesis of indole. Ethyl 2,4-dinitrophenylcyanoacetate (I) and ethyl 2-nitro-4-carbethoxyphenylcyanoacetate (II) were prepared in good yield, but when subjected to the conditions of Stephen's method gave products containing one more atom each of nitrogen and hydrogen than the expected indole derivatives. The chemical behavior and infrared and ultraviolet spectra indicate that the product from (II) is 2-amino-3,6-dicarbethoxyindole (III) and the product from (I), 2,6-diamino-3-carbethoxyindole (IV).

When (II) was hydrogenated under 65 pounds pressure at 80-90° in the presence of 30% palladium on Darco, 3,6-dicarbethoxyindole (V) was obtained in 90% yield. Hydrogenation of (II) under several other sets of conditions gave (V), always in greater than 50% yield, but (III) could not be converted to (V) catalytically.

Ethyl 3-nitro-4-cyanomethylbenzoate (VI) was prepared by brominating ethyl p-toluate with N-bromosuccinimide, treating the product with potassium cyanide and then nitrating. When (VI) was hydrogenated in the presence of 30% palladium on Darco, 6-carbethoxyindole (VII) was obtained in 75% yield. In an attempt to make 2-nitro-4-cyanobenzyl cyanide (VIII), p-tolunitrile was brominated with N-bromosuccinimide and converted to the dinitrile with potassium cyanide, but the product could not be nitrated. When p-fluorotoluene was brominated, converted to the nitrile and nitrated, a mono- and a dinitro compound was isolated. The infrared spectra indicated that these were 2-nitro-4-fluorobenzyl cyanide (IX) and α-nitro-α-(2-nitro-4-fluorophenyl)-acetonitrile (X). The latter, when hydrogenated in the presence of 30% palladium on Darco, did not cyclize. The product was 2-amino-4-fluorobenzyl cyanide. Indole itself was prepared by hydrogenation of o-nitrobenzyl cyanide in 67% yield.

When (VII) was treated with formaldehyde and dimethylamine, 6-carbethoxygramine was obtained.

84 pages. $1.05. Mic 56-1372

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SOME REACTIONS OF DISUBSTITUTED PHOSPHINE OXIDES

(Publication No. 16,312)

Robert Clay Miller, Ph.D.
Temple University, 1956

Unsymmetrical tertiary phosphine oxides have been prepared by the base-catalyzed addition of disubstituted phosphine oxides, $R_2P(O)H$, to various activated olefinic double bonds. Similar addition reactions of dialkyl phosphonates, $(RO)_2P(O)H$, have been reported in the literature. Di-n-octylphosphine oxide and particularly dibenzylphosphine oxide have been added to the activated olefins using catalytic amounts of sodium ethoxide in ethanol. The unsaturated compounds which have been treated include acrylonitrile, methacrylonitrile, 3-butenenitrile, ethyl acrylate, ethyl methacrylate, ethyl crotonate, ethyl cinnamate, and acrylamide. In each case, the phosphinyl group adds to the olefinic carbon atom furthest removed from the activating group. Hydrolysis of the addition products, nitriles, esters, and an amide, yields the appropriate 2-disubstituted phosphinylpropionic acid. Both disubstituted phosphine oxides have been similarly added to diethyl maleate to give diethyl disubstituted phosphinylsuccinates which, on hydrolysis, yield the corresponding succinic acids, $R_2P(O)CH(COOH)CH_2COOH$. Heating the succinic acids results in decarboxylation and formation of the corresponding 2-disubstituted phosphinylpropionic

acid, $R_2P(O)CH_2CH_2COOH$. These compounds are shown to be identical to the appropriate hydrolysis product of the acrylonitrile, acrylamide, or ethyl acrylate adduct. Both chemical analyses and infrared spectra are in agreement with the assigned structures.

Analogous additions of disubstituted phosphine oxides to α,β-unsaturated ketones, benzalacetone and benzalacetophenone, have been carried out. 2,4-Dinitrophenylhydrazone formation and infrared spectra indicate the products to be 1,4-adducts, β-(disubstituted phosphinyl) ketones, $R_2P(O)CH(R')CH_2COR''$. Dibenzylphosphine oxide is shown to undergo a base-catalyzed 1,2-addition to cinnamaldehyde to form 1-dibenzylphosphinyl-3-phenyl-2-propen-1-ol, $(C_6H_5CH_2)_2P(O)CH(OH)CH{:}CHC_6H_5$.

A number of disubstituted phosphine oxide addition reactions have been carried out with aldehydes and ketones in the presence of traces of base to yield α-disubstituted phosphinyl alcohols, $R_2P(O)C(OH)(R')R''$. Infrared spectra and elemental analysis agree with the assigned structures. Dibenzylphosphine oxide and, to a lesser extent, di-n-octylphosphine oxide have been added to such carbonyl compounds as, acetaldehyde, propionaldehyde, butyraldehyde, isobutyraldehyde, benzaldehyde, 2-nitrobenzaldehyde, 3-nitrobenzaldehyde, 4-nitrobenzaldehyde, 4-dimethylaminobenzaldehyde, salicylaldehyde, piperonal, furfural, acetone, 2-butanone, cyclopentanone, and cyclohexanone. Comparison of the infrared spectra of these adducts with dialkyl phosphonate-carbonyl compound adducts are made. Whereas the phosphine oxide-carbonyl addition compounds are stable in hot dilute hydrochloric acid, hydrolysis with base leads to cleavage of the adduct to the salt of the disubstituted phosphinic acid and a second fragment, presumably an alcohol. The dibenzylphosphine oxide-benzaldehyde adduct has been prepared in another manner by adding the benzylmagnesium chloride-dialkyl phosphonate reaction complex to benzaldehyde. This apparently general reaction for preparing α-disubstituted phosphinyl alcohols was successful in the preparation of 1-diphenylphosphinyl-1-phenylmethanol, $(C_6H_5)_2P(O)CH(OH)C_6H_5$, from phenylmagnesium bromide, di-n-butyl phosphonate, and benzaldehyde.

A number of miscellaneous reactions of disubstituted phosphine oxides have been briefly investigated. The phosphine oxides have been added to the carbon-nitrogen double bond of benzalaniline to yield tertiary phosphine oxides, $R_2P(O)CH(C_6H_5)NHC_6H_5$. The reaction of di-n-octylphosphine oxide with carbon tetrachloride yields hydrogen chloride, chloroform, and an uncharacterized coupled product. This product can be hydrolyzed under acidic conditions in the presence of air to give two moles of di-n-octylphosphinic acid, $(C_8H_{17})_2P(O)OH$. The sodium salt of di-n-octylphosphine oxide has been alkylated with n-octyl bromide to form tri-n-octylphosphine oxide, $(C_8H_{17})_3PO$. The phosphoryl group of di-n-octylphosphine oxide is readily complexed with hydrogen chloride gas to form a liquid which no longer contains the phosphoryl group. Addition of water reverses the reaction, regenerating the di-n-octylphosphine oxide.

183 pages. $2.29. Mic 56-1373

I. ORIENTATION IN ADDITIONS TO SUBSTITUTED p-BENZOQUINONEDIBENZIMIDES. II. REACTIONS OF 2,3,5,6-TETRACHLORO-p-BENZOQUINONEDIBENZENESULFONIMIDE.

(Publication No. 16,416)

Harry Jacob Neumiller, Jr., Ph.D.
University of Illinois, 1956

PART I: INTRODUCTION

The orientations in the products resulting from the addition of hydrogen chloride to 2-chloro-p-benzoquinonedibenzenesulfonimide (1) and to 2-chloro-p-benzoquinonedibenzimide (2) were found to be completely different. Since the orientations in the products of a number of other addition reactions of monosubstituted p-benzoquinonedibenzenesulfonimides have been previously determined, (1,3,4,5) it was of interest to study further the addition reactions of monosubstituted p-benzoquinonedibenzimides. The purposes of this investigation were (a) the elucidation of the structures of the products of certain previously discovered addition reactions of monosubstituted p-benzoquinonedibenzimides, and (b) further studies on the addition of reagents to monosubstituted p-benzoquinonedibenzimides.

DISCUSSION OF RESULTS

The x-acetoxy-2-chloro-p-phenylenedibenzamide which was found earlier, (6) to result from both the reaction of acetic acid with 2-chloro-p-benzoquinonedibenzimide (I) and the reaction of hydrogen chloride with 2-acetoxy-p-benzoquinonedibenzimide was prepared by the former of these two methods. It was identified as 2-acetoxy-6-chloro-p-phenylenedibenzamide, through its conversion by hydrolysis and methylation to 2-chloro-6-methoxy-p-phenylenedibenzamide (II).

The oxidation of 2-methoxy-p-phenylenedibenzamide with lead tetraacetate in benzene did not afford 2-methoxy-p-benzoquinonedibenzimide as an isolable compound. The addition of hydrogen chloride to this diimide was accomplished in situ, and the resulting products were identified as 2-chloro-5-methoxy-p-phenylenedibenzamide (III) and II.

The unequivocal synthesis of III was accomplished by a sequence which involved first the benzoylation of 2-amino-4-chloro-5-nitroanisole, to give 5′-chloro-2′-methoxy-4′-nitrobenzanilide; this was reduced to 4′-amino-5′-chloro-2′-methoxybenzanilide, which was benzoylated to afford III.

The unequivocal synthesis of II involved two separate sequences of reactions. 2-Amino-5-nitroanisole was chlorinated to give 2-amino-3-chloro-5-nitroanisole (IV); this was reduced to 2-chloro-6-methoxy-p-phenylenediamine, which was benzoylated to give II. The position of the chlorine atom in IV was established by the acetylation and subsequent nitration of 2-amino-3-chloroanisole, to afford 2-chloro-6-methoxy-4-nitroacetanilide; the same compound was obtained upon acetylation of IV.

The acid-catalyzed addition of methanol to I was attempted, but no identifiable products were obtained.

PART II: INTRODUCTION

Previous investigation has shown that 2,3,5,6-tetrachloro-p-benzoquinonedibenzenesulfonimide(I) reacts with

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a variety of non-para-substituted aromatic amines to afford adducts comprised of one molecule of I and one molecule of the amine. (7) It was postulated that the aniline adduct of I was N-(p-aminophenyl)-N,N′-dibenzenesulfonyl-2,3,5,6-tetrachloro-p-phenylenediamine, and similar structures were proposed for the other adducts. The purposes of this investigation were (a) the elucidation of the structures of the amine adducts of I, and (b) studies on the reactivity of I toward other reagents.

DISCUSSION OF RESULTS

The aniline adduct of I was cleaved by cold concentrated sulfuric acid to a compound which was postulated to be 4,4′-diamino-2,3,5,6-tetrachlorodiphenylamine(II). The attempted unequivocal synthesis of II was not successful.

Phenol, o-cresol, and 2,5-dimethylphenol reacted with I to give unstable adducts comprised of one molecule of each of the reactants. These adducts could not be obtained in a state of analytical purity. Anisole did not react with I.

Acetylacetone reacted with I, in the presence of a catalytic amount of triethylamine, to give an adduct which was comprised of one molecule of each of the reactants, but which could not be obtained in a state of analytical purity.

Anthracene reacted with I to give an unstable adduct which could not be characterized.

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165 pages. $2.06. Mic 56-1374

I. THE WAGNER-MEERWEIN REARRANGEMENT OF THE DIASTEREOISOMERIC 1-p-CHLOROPHENYL-1-PHENYL-2-PROPANOLS. II. THE STEREOSPECIFIC SYNTHESES OF THE DIASTEREOISOMERIC 1-p-ANISYL-1-PHENYL-1,2-PROPANEDIOLS.

(Publication No. 16,430)

Ruth Adams Strojny, Ph.D.
University of Illinois, 1956

PART I

dl-threo- and erythro-1-p-Chlorophenyl-1-phenyl-2-propyl p-bromobenzenesulfonates were prepared and solvolyzed at 65° in anhydrous acetic acid. The mixtures of acetates resulting from the solvolyses were analyzed using infrared and ultraviolet light. dl-threo-Brosylate yielded a mixture consisting of about 10% threo-1-phenyl-2-p-chlorophenyl-1-propyl acetate, 68% threo-1-p-chlorophenyl-2-phenyl-1-propyl acetate, 10% erythro-1-p-chlorophenyl-2-phenyl-1-propyl acetate, 8% olefin and no detectable amount of erythro-1-phenyl-2-p-chlorophenyl-1-propyl acetate. dl-erythro-Brosylate gave a mixture consisting of approximately 32% threo-1-phenyl-2-p-chlorophenyl-1-propyl acetate, 39% threo-1-p-chlorophenyl-1-phenyl-1-propyl acetate, 1% erythro-1-p-chlorophenyl-2-phenyl-1-propyl acetate, 11% olefin and no detectable amount of erythro-1-phenyl-2-p-chlorophenyl-1-propyl acetate. Each of the product acetates was stereospecifically synthesized. The configurations of the starting brosylates were assigned on the basis of the solvolyses results and the cis effect. The steric factor (S) for methyl-aryl interference and the electric factor (E) for p-chlorophenyl vs. phenyl were calculated from the above results to be 2.6 and 0.32, respectively, in the transition state.

PART II

Essentially pure α-hydroxypropiophenone and p-methoxy-α-hydroxypropiophenone were prepared from lactonitrile and the corresponding Grignard reagent. These keto-alcohols were found to be isomerized by acids and bases but they undergo stereospecific addition to Grignard reagents to give the expected, unrearranged diastereoisomers. Thus, α-hydroxypropiophenone and p-anisylmagnesium bromide yield erythro-1-p-anisyl-1-phenyl-1,2-propanediol, m.p. 90°. p-Methoxy-α-hydroxypropiophenone and phenyl magnesiumbromide yield threo-1-p-anisyl-1-phenyl-1,2-propanediol, m.p. 83°.

174 pages. $2.18. Mic 56-1375

THE REACTIONS OF ORGANOMETALLIC COMPOUNDS WITH DIAZONIUM SALTS

(Publication No. 16,434)

Joanne Arnheim Ursprung, Ph.D.
University of Illinois, 1956

When attempts to repeat the experiments of Oda from which he obtained biphenyls by the reaction of the benzenediazonium chloride-zinc chloride salt with Grignard reagents resulted, instead in the production of the corresponding azo compounds, it became of decided interest to study this type of reaction.

As a result, under conditions similar to those employed by Oda, the reaction of p-chlorophenylmagnesium bromide with the benzenediazonium chloride-zinc chloride double salt resulted in the formation of p-chloroazobenzene. The use of p-chlorophenyllithium in a similar reaction yielded no isolable products, whereas the reactions of p-chlorophenylzinc chloride and di-p-chlorophenylcadmium with benzenediazonium fluoborate yielded only p-chloroazobenzene. In no case was p-chlorobiphenyl isolated. To study the generality of this type of reaction in the aromatic series, benzenediazonium fluoborate was treated separately with p-methoxyphenylzinc chloride and mesitylzinc chloride. Low yields of the corresponding azo compounds were obtained.

A study of the effect of substituents on the above reactions indicated that substituents in the o-p positions reduced the yield of azo compounds and produced no other isolable neutral products.

To extend the scope of this research, aliphatic

organometallic reagents were allowed to react with benzenediazonium fluoborate using conditions similar to those above. Some rather interesting reactions among those studied were those of benzenediazonium fluoborate with methylmagnesium iodide, methylzinc chloride, and dimethylcadmium (the latter two reagents were prepared from methylmagnesium iodide). Iodobenzene was obtained in high yields. Butylzinc chloride and dibutylcadmium afforded very low yields of benzeneazobutane. In contrast to this, however, t- butylmagnesium bromide and t-butylzinc chloride gave benzeneazo-t-butane in relatively good yields. This azo compound was hitherto unknown. When benzylmagnesium chloride and benzylzinc chloride were allowed to react with benzenediazonium fluoborate, tautomerism of the primary product occurred, and only benzaldehydephenylhydrazone was obtained. Triphenylvinylmagnesium bromide, when subjected to the same reaction, yielded no isolable product, whereas triphenylvinylzinc chloride gave triphenylethylene presumably due to the hydrolysis of this fairly unreactive organometallic reagent.

When the diazonium salt, which is insoluble in ether, was dissolved in pyridine, the yields of azo compounds were decreased. When cobalt chloride was used as a catalyst in the reaction of benzenediazonium fluoborate with p-chlorophenylzinc chloride in an attempt to induce a free radical type of reaction, a low yield of p-chloroazobenzene was obtained and none of the expected p-chlorobiphenyl was obtained. 81 pages. $1.01. Mic 56-1376

PART I: THE STRUCTURES OF FRIEDELIN AND CERIN. PART II: THE STRUCTURE OF URBANINOL.

(Publication No. 15,282)

Joseph John Ursprung, Ph.D.
University of Illinois, 1955

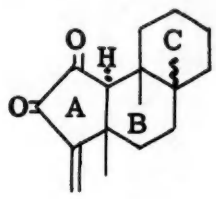
The terpenoid ketones friedelin and cerin belong to a new class of pentacyclic triterpenes. Since the unit

$$-\overset{|}{C}H-\overset{|}{C}H-CO-CH_2-CH_2-$$

has been shown to be present in the molecule since 1,8-dimethylpicene is formed on dehydrogenation, the carbonyl group of friedelin can only be at C_1 or C_3 using the normal numbering for triterpenoids. A methyl group was shown to be adjacent to the carbonyl group, thus placing the oxygen function at C_3.

Bromination of friedelin produces 2-bromofriedelin while bromination of friedelin-enol benzoate furnishes 4-bromofriedelin. Silver acetate treatment of 4-bromofriedelin yields an unsaturated, unconjugated ketone which indicates the presence of a methyl group at C_5. 2-Bromofriedelin is not epimerized by hydrogen bromide, which proves the trans-locking of rings A/B and the presence of a hydrogen at C_{10}. The change in molecular rotation due to axial bromine at C_2 ($\triangle M_D$ -651) and that due to axial bromine at C_4 ($\triangle M_D$ +614) reveals that bromine is α-oriented in both 2- and 4-bromofriedelin, the methyl at C_5 is β and the hydrogen at C_{10} is α, thus showing the absolute configuration of the molecule.

Stepwise oxidation of norfriedelendione I with hydrogen peroxide and ozone produces the ketone II. Excess deuterium bromide on II results in the incorporation of one deuterium atom / molecule proving the presence of a methyl group at C_9 and confirming the presence of a methyl



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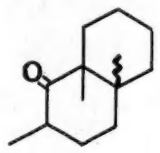

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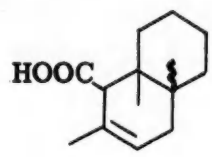
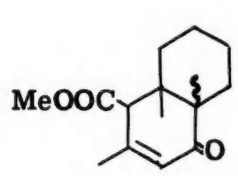
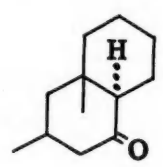


III

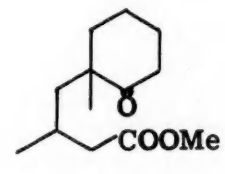
group at C_5. Alkaline peroxide oxidizes I to give the unsaturated acid III. Dichromate oxidation of the methyl ester of III gives IV which on alcoholysis followed by hydrogenation furnishes the ketone V. Deuterium exchange with deuterium bromide (2.9 deuterium atoms/molecule) as well as the conversion of V to the ester VI shows the presence of a hydrogen at C_8. Rings B/C and C/D in friedelin are trans-locked as shown by chemical evidence as well as x-ray studies of friedelan-3α-ol chloroacetate.



IV

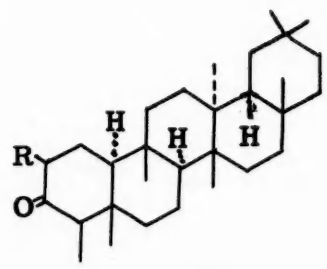


V



VI

Methyl groups must be present at C_{13} and C_{14} since 1,2,8-trimethylphenanthrene and 1,2,7-trimethyl naphthalene are formed by selenium dehydrogenation of friedelan-3α-ol. The remaining methyl groups were shown to be at C_{17} and C_{20} by a remarkable rearrangement of friedelan-3β-ol to olean-13(18)-ene by strong acid treatment. This gives a direct correlation with β-amyrin and shows beyond doubt the structure and stereochemistry of friedelin (VII, R=H) and cerin (VII, R=OH).



VII

A biosynthetic pathway from squalene to an intermediate β-amyrin-type structure followed by reversal of the rearrangement mentioned above is suggested for the formation of friedelin. 76 pages. $1.00. Mic 56-1377

CATALYSIS IN THE AMMONOLYSIS AND HYDROLYSIS OF METHYL ACETATE: A DETERMINATION OF THE VELOCITY CONSTANTS, ENERGIES OF ACTIVATION, AND ENTROPIES OF ACTIVATION

(Publication No. 16,351)

George Robert Wolf, Ph.D.
University of Pennsylvania, 1956

Supervisors: Allan R. Day and John G. Miller

The velocity constants have been determined for the ammonolysis of methyl acetate with catalysts of the type

using ethylene glycol as reference standard. The catalysts were lactamide; N-methyllactamide; N, N-dimethyllactamide; and alpha-hydroxyisobutyramide. The reaction mixtures consisted of 1 molar catalyst, 10 molar water, 2 molar ammonia, and 1 molar ester.

In studying the ammonolysis reaction there is a competing reaction of a lesser magnitude, hydrolysis. The ratio of ammonolysis to hydrolysis is determined, permitting the calculation of the velocity constants of both hydrolysis and ammonolysis.

Ten milliliter aliquots were put into ampoules and the ampoules were sealed while in an ice-slurry bath. All but two ampoules were then put into a constant temperature bath and zero-time was recorded. The two ampoules that were kept out were titrated to determine the zero-time concentration of ammonia and the formaldehyde blank. Periodically samples were withdrawn from the bath and titrated to determine the amount of ammonia used and the ratio of ammonolysis to hydrolysis. Velocity constants were determined at 20°, 30° and 40°C.

Using the velocity constants of both ammonolysis and hydrolysis the energies of activation and entropies of activation have been calculated for both the ammonolysis and hydrolysis reactions.

The differences between the velocity constants, energies of activation, and entropies of activation for the various catalysts are small, but ethylene glycol still appears to be the most effective catalyst yet found in this laboratory.

There is a fairly large difference between the velocity constants, energies of activation, and entropies of activation for hydrolysis and for ammonolysis. The velocity constants for ammonolysis are about ten times that for hydrolysis. The energies of activation are about 6,000 calories larger for hydrolysis than for ammonolysis. The entropies of activation are about twelve e.u. less for hydrolysis than for ammonolysis. A possible explanation has been given in the different manner that the activated complexes are formed. 53 pages. $1.00. Mic 56-1378

CHEMISTRY, PHYSICAL

TRYPSIN MONOLAYERS AT THE WATER-AIR INTERFACE. A STUDY OF THE INFLUENCE OF MODE OF FORMATION AND OF IRRADIATION UPON ENZYMATIC ACTIVITY.

(Publication No. 16,378)

Leroy George Augenstine, Ph.D.
University of Illinois, 1956

In the present study several techniques have been adapted to an integrated study of the effect of radiation on monolayers of trypsin spread at a liquid-air interface.

The Wilhelmy method of measuring film pressures was modified by the introduction of electronic mechanisms for controlling and determining end-points. This increased its speed and accuracy and also makes feasible automatic measurement and recording of film pressures if such is desired.

A study was made of the effect of various factors on the enzymatic activity which could be recovered from trypsin monolayers. Two methods of spreading and seven methods of recovery were investigated. Simple but accurate procedures were finally evolved and used in the majority of the experiments.

The relation between film pressure and surface concentration was determined as a function of the history of the film. It was found that an important factor determining both film pressure and recoverable activity is the age of the film. The effects of temperature and surface contamination on the film pressure were also investigated.

The film pressure and recoverable activity were found to be unaffected by irradiation with as much as 1000 r of x-rays. This is in sharp contrast to the very high dosage responses found by Mazia and Blumenthal (J. Cell. Comp. Physiol.; 35:suppl. 1, 171-186 (1950)) for mixed films of pepsin and albumin.

Irradiation with UV gave a constant percent of inactivation at a given dose for surface concentrations of greater than $35\gamma/cm^2$. This percent inactivation varied with dosage so that the quantum yield was independent of dosage and the mode of inactivation was a one-hit event. For concentrations between 20γ and 30γ the percent inactivation did not remain constant for a given dosage. For these lower concentrations, the quantum yield was a function of both dosage and concentration; as the concentration decreased it seemed that the inactivation became a multiple-hit rather than a one-hit event. (The multiplicity increased monotonically as the surface concentration decreased.) All of the quantum yields were found to differ by about 10^5 with those reported by Mazia and Blumenthal; however, they agree within a factor of 2-5 of those reported for UV irradiation in solution.

One of the purposes of this investigation was to study how the radiation response, as measured by enzymatic activity, depends upon the physical state of the enzyme. It was pointless to irradiate gaseous films since the molecules in them lost their biological activity during film formation. However, further study may reveal that the changes in multiplicity and quantum yield are associated with changes in the physical state of the molecules.

One of the main reasons for this study was to attempt to verify by experiment predictions arising from the hypothesis on protein structure advanced by the author.

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Although most of the results are in agreement with the predictions, some findings, such as the multiplicity changes, are not explained as yet by the hypothesis.

156 pages. $1.95. Mic 56-1379

THE DEVELOPMENT OF A FAST AND SENSITIVE MAGNETIC SUSCEPTOMETER FOR THE STUDY OF RAPID BIOCHEMICAL REACTIONS

(Publication No. 16,317)

Arthur S. Brill, Ph.D.
University of Pennsylvania, 1956

Supervisors: Britton Chance and Hendrik den Hartog

Magnetic susceptibility measurements are made on the hemoproteins, their complexes, and their compounds to get information about the bonding of the iron. The hemoprotein enzymes are to be studied in the course of the rapid reactions which they catalyze and a fast magnetic susceptometer is required. The limited availibility of many hemoproteins and the effect of the concentration of the hemoprotein enzymes upon the rates of reactions which they catalyze require low concentration and hence a sensitive instrument. This dissertation describes the development of a rapid and sensitive magnetic susceptometer.

The basic instrument is a Rankine balance. The sensitivity is increased over previous models by using an improved design for the cell which contains the solution under investigation. Discrimination against vibrational disturbances is introduced for the first time. A special site is selected for low levels of magnetic and vibrational disturbance. The higher sensitivity and lower noise result in the ability to detect in one measurement a change in volume magnetic susceptibility of 6×10^{-12} e.m.u., an improvement of seventy times over previous models. The response time of the present instrument is adjustable down to a fraction of a second by means of an electronic servo system.

A non-magnetic, vibrationless, temperature controlled flow system using a new type of pump produces steady-state reaction mixtures in the observation cell so that chemical reactions can be studied. The time resolution of this system is at present limited by the geometry of the cell to five seconds. Disturbances accompanying flow increase the noise level so that the minimum detectable change in volume magnetic susceptibility in one measurement is 1×10^{-11} e.m.u.

A time resolution during flow of 0.1 second is feasible as is the detection in one measurement of the change in magnetic susceptibility of 1×10^{-12} e.m.u. corresponding to the r.m.s. Brownian force arising from the air resistance to the magnet's motion.

The formation of the compound of horse myoglobin and methyl hydrogen peroxide was observed magnetically. The molar magnetic susceptibility of the compound at the instant of its formation is 2870×10^{-6} e.m.u. $\pm$ 6% at 20°C.

245 pages. $3.06. Mic 56-1380

STUDIES ON THE DIFFUSION COEFFICIENTS OF BINARY GAS SYSTEMS

(Publication No. 16,151)

Robert Edwin Bunde, Ph.D.
The University of Wisconsin, 1955

Supervisor: Professor Paul Bender

The interferometric technique was employed for the measurement of the diffusion coefficients of three binary gas systems in the temperature range from 25°C to 85°C at one atmosphere pressure. A fourth system was used to study the concentration dependence of the diffusion coefficient at 25°C. Utilizing a typical Loschmidt-type cell employing a shear technique for opening and closing, the diffusion process was followed by measuring the time rate of change of concentration at one point in the cell. A light path through the lower half-cell permitted the observation of the shift of the fringe pattern in a Mach-Zehnder interferometer caused by the continual change in the refractive index of the gas as diffusion progressed. The fringe pattern and time were recorded on film at selected intervals, while the integral fringe shift was obtained by visual observation. A toolmaker's microscope with a coordinate comparator stage was used to determine the fractional part of the fringe shift from the film. A knowledge of the integral fringe shift, time, temperature and pressure permitted the calculation of the diffusion coefficient.

Values of the diffusion coefficient at one atmosphere pressure for pairs of gases among the single components hydrogen, nitrogen, and ammonia are as follows:

Gas Pair	Temp (°K)	Diffusion coefficient (cm^2/sec)
Hydrogen-Nitrogen	298,16	0.7835
	328.16	0.9079
	358.16	1.052
Hydrogen-Ammonia	298.16	0.7830
	328.16	0.9426
	358.16	1.0933
Nitrogen-Ammonia	298.16	0.2300
	328.16	0.2847
	358.16	0.3283

Concentration dependence studies on the fourth system, Hydrogen-Helium, at 298.16°K and one atmosphere pressure yielded the following results:

Helium concentration mole fraction		Diffusion coefficients (cm^2/sec)
Initial mixture upper half-cell	Final mixture total cell	
0.0000	0.5000	1.549
0.1490	0.5745	1.550
0.4337	0.7269	1.572

The Mach interferometer was developed to the point of yielding optimum accuracy, so accurate diffusion coefficients would be available for correlation with the existing intermolecular force theories. The interdiffusion of gases depends primarily on the force fields of the diffusing

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molecules. Thus the relations of Chapman and Enskog and a knowledge of the values of the coefficients make it possible to infer something concerning the nature of the forces between the unlike molecules. Example: calculations of the various methods of correlation were performed for the square-well, the Lennard-Jones (6-12), and the modified Buckingham intermolecular potential functions. 160 pages. $2.00. Mic 56-1381

PHYSICOCHEMICAL STUDIES OF SERUM LIPOPROTEINS

(Publication No. 15,193)

Henry Lewis Crespi, Ph.D.
University of Illinois, 1955

Low-density lipoproteins from the sera of various species, mainly human and rabbit, but including dog and chicken, were isolated ultracentrifugally according to the method of Gofman. These lipoproteins were studied with respect to stability, composition, and interaction with various substances of oxidative or lipophilic character. In stability tests, small aliquots of lipoprotein concentrate were dialyzed against large volumes of external solution which contained dissolved materials under test. Ultracentrifugal analysis was the chief analytical method utilized. Spectral and manometric techniques were also used.

Experiments on the stability of rabbit serum lipoprotein showed that a characteristic degradation of this material is catalyzed by minute traces of cupric ion and not by Fe^{++}, Fe^{+++}, Ag^{+}, Al^{+++}, Hg^{++}, Pb^{++}, Sn^{++}, Zn^{++}, Pt^{++}, Co^{++}, Cd^{++}, or Ni^{++} ions. Stability resulted if Cu^{++} was present but bound by a complexing agent or else if a suitable antioxidant was present. Analogous behavior was noted for lipoprotein from human, chicken, and dog sera. The ions Co^{++} and Mn^{++} were tested against lipoprotein from human and chicken sera, but were without activity.

Several experiments were performed which indicated that there were no major differences in either the lability of lipoprotein from the serum of human males and females nor the lability of the S_f 0-20 group as compared to the S_f 20-400 group in human or chicken lipoprotein. The comparative stabilities of lipoproteins from the sera of chickens of various experimental diets was also examined.

The stabilizing influence of a number of agents and conditions was studied. Rutin and hesperidin were found to be active as protective agents. The effect of antioxidants was pH dependent. Saturation with nitrogen prevented degradation even in the presence of cupric ion. Subjection of the lipoprotein to H_2O_2 or Co^{60} irradiation, in the presence of cupric ion, hastened the degradative process. The data were all consistent with the premise that the degradation was oxidative in nature.

Manometric experiments and infra-red and ultraviolet analyses of lipoprotein showed that the degradation was an oxidation, involving probably both cholesterol and fatty acids—certainly at least one of these. The Warburg experiments with human lipoprotein indicated that 400 molecules of O_2 added to each lipoprotein molecule (assumed molecular weight 1,300,000). The spectral analyses indicated not only an addition of oxygen to the lipid material, but a shift from a cis to a trans configuration.

Serum lipoprotein was also shown to interact with certain lipophilic compounds. Octanol, decanol, decane, and oleic acid interacted to give greatly increased flotation rates; DDT, desoxycholic acid, and degradation products caused decreased flotation rates. Experiments with cholesterol were not definitive, but an interaction is believed to occur in this case also. Decamethylene glycol, sebacic acid, methyl-n-butyl ketone, and cyclohexanol showed slight or no interaction. 95 pages. $1.19. Mic 56-1382

THE ISOTOPIC EXCHANGE REACTION OF ETHYL IODIDE WITH IODINE

(Publication No. 16,442)

Leonard Ray Darbee, Ph.D.
The University of Buffalo, 1956

The isotopic exchange reaction of iodine with liquid ethyl iodide was studied. Small amounts of ethanol greatly accelerated the reaction. This placed stringent demands on the purification of the ethyl iodide. The rate expression depends on the first power of the iodine concentration, and is independent of the ethyl iodide concentration. The activation energy of the reaction is 19.5 K. cal./mole.

In the presence of small amounts of ethanol the initial exchange rate increases linearly with ethanol content. Extrapolation of these results to zero ethanol content gives essentially the same rate of exchange as obtained with pure ethyl iodide.

Under appropriate concentration restrictions the study of competetive exchange reactions yields the relative rates of the individual exchanges. Methyl iodide exchanges with iodine about seven and one-half times more rapidly than ethyl iodide.

A mechanism for exchange is proposed which depends on the intimate association of ethyl iodide with iodine, in which the iodine molecules are completely encaged by the ethyl iodide molecules. 60 pages. $1.00. Mic 56-1383

STUDIES IN ELECTROANALYTICAL CHEMISTRY: I. DIFFUSION CURRENTS AT SPHERICAL ELECTRODES. II. REDUCTION OF IODATE AT THE ROTATING PLATINUM ELECTRODE.

(Publication No. 16,161)

Robert Peter Frankenthal, Ph.D.
The University of Wisconsin, 1956

Supervisor: Assistant Professor Irving Shain

I. The equation for current-voltage curves under certain conditions was obtained by solving the partial differential equation for spherical diffusion. These conditions are:

1. The electro-active species can reach the electrode surface only by diffusion.

2. The rate of potential change is linear with time.
3. None of the product is present at zero time.
4. No concentration gradient exists at zero time.
5. The working electrode is a stationary sphere.

A numerical method of approximating the differential by finite differences was used.

Since it was not possible to state the dependency of the current on all the experimental parameters explicitly, a family of curves was constructed from which this dependency could be determined.

The theory was verified experimentally by studying the reduction of thallous and lead ions at a stationary spherical mercury electrode.

II. A unified theory of polarographic waves was developed where the mode of mass transfer of the reactant to the electrode surface is both diffusion and convection and where the electrode has a constant area.

Attempts to verify the theory by studying the reduction of iodate at the rotating platinum electrode were unsuccessful because surface effects on the electrode prevented reproducibility of results. 94 pages. $1.18. Mic 56-1384

A STUDY OF CONCENTRATION DEPENDENT DIFFUSION PROCESSES

(Publication No. 16,402)

Leonard Maxwell Isaacson, Ph.D.
University of Illinois, 1956

In the study of ordinary diffusion processes it is often assumed, for the sake of simplicity, that the diffusion coefficient is independent of concentration. A study was undertaken to investigate the effect of concentration dependence in ordinary diffusion processes. Specifically, two concentration dependent forms were chosen for the diffusion coefficient: one form for electrolytes, the other for non-electrolytes.

Two experimental techniques were considered: (1) The so called "frit method," in which a thin porcelain disc, containing a solution of given concentration, is suspended from an analytical balance and immersed in a large bath of different concentration. The change of weight of the frit is then observed as a function of time. (2) The "layer method," in which three volumes of solvent are superimposed on one volume of solution in a column of uniform cross section. Diffusion is allowed to procede for a given time and then the column is separated into four equal layers, after which the individual layers are analyzed.

The concentration dependent forms for the diffusion coefficient were substituted into the diffusion equations corresponding to the two experimental techniques, resulting in non-linear partial differential equations. Solutions for the diffusion equations were obtained numerically, in terms of convenient dimensionless parameters, by means of a high speed electronic digital computer.

In the case of the frit method, a plot of the data resulted in a series of curves which approached to straight lines all having the same slope. It could be shown from this that the frit method gives the diffusion coefficient of the outside bath.

In the case of the layer method it was found that, in order to obtain accurate concentration dependences, a slope analysis, similar to that of the frit method, would be required. 70 pages. $1.00. Mic 56-1385

THE EFFECT OF PRESSURE ON THE VISCOSITY OF POLYMER SOLUTIONS

(Publication No. 16,405)

Carl William Kammeyer, Ph.D.
University of Illinois, 1956

A study of the effect of pressure on the viscosity of dilute solutions of polymer molecules has been undertaken with a view to obtaining information concerning their configuration and interaction with the solvent. The only investigation of this type reported previously is that of Ebbecke and Haubrich,[1] who studied starch and glycogen. Bridgman has made a general study[2] of the effect of pressure on the viscosity of pure liquids.

An apparatus has been developed for measurement of viscosities of solutions under applied pressures up to one thousand atmospheres. The viscosities are measured by determining the time for a tight-fitting ball to roll between two fixed points in a glass tube, using a detection method based on the change in mutual inductance of a pair of narrow coils as the steel ball passes through their core. The e.m.f. pulse produced operates a timer by means of electronic circuits, which are described in detail. Pressure is transmitted to the solution under study through a plastic bag sealed to the end of the tube. A conventional pressure system is employed, with the bomb mounted so that its inclination may be changed. The temperature of the bomb is controlled by circulating water from a constant temperature bath through jackets sealed on the bomb. Due to uncertainties in the geometry of the apparatus, only viscosities measured at the same pressure may be compared.

Viscosity data were determined for benzene and benzene solutions of two polystyrene fractions at 30°C and 1, 518 and 828 bars. The precision is better than five per cent. Freezing of the solutions, which occurs at about 850 bars at this temperature, prevented measurements from being made at higher pressures. It is shown that the effect of pressure on the relative viscosities of these solutions, if any exists, is small. This is in line with the qualitative observations of Ebbecke and Haubrich.[1] Because of uncertainties in the concentrations, intrinsic viscosities could not be obtained.

Suggestions are made for improvement of the apparatus and method.

The method also shows promise for use with solutions which are electrical conductors or which are corrosive.
64 pages. $1.00. Mic 56-1386

1. Ebbecke, U., and Haubrich, R., Arch. ges. Physiol. (Pflügers) 238, 429 (1936); Biochem. Z. 303, 242 (1939).

2. Bridgman, P. W., The Physics of High Pressure, Bell and Sons, London, 1949, Chapter XII.

REACTION VELOCITIES IN HETEROGENEOUS LIQUID-LIQUID SYSTEMS

(Publication No. 16,335)

John Michael Koch, Ph.D.
University of Pennsylvania, 1956

Supervisors: Dr. Martin Kilpatrick
Dr. Mary L. Kilpatrick

The rate of reaction between iodine dissolved in a layer of bromobenzene and sodium thiosulfate dissolved in a layer of water on top of the bromobenzene layer was studied in systems where the concentration of iodine in the bromobenzene layer was much greater than that of the thiosulfate in the water layer, and where the iodine concentration was much smaller than the thiosulfate concentration. This system also was studied at different temperatures and at different rates of stirring of the two layers to determine the effect of temperature and agitation on the rate of the iodine-thiosulfate reaction taking place at the bromobenzene-water interface.

When the concentration of iodine was greatly in excess of the thiosulfate concentration, the rate of an individual reaction was constant and dependent primarily upon the initial iodine concentration. In experiments where the initial thiosulfate concentration was below about 0.1 molar, the rate of reaction was proportional to the initial thiosulfate concentration, but above this concentration the reaction rate was relatively independent of the thiosulfate concentration. When the thiosulfate concentration was kept high and the initial iodine concentration was below 0.02 molar, the initial rate of the reaction changed very rapidly with changes in the initial iodine concentration. This behaviour may be due to positive adsorption of iodine at the liquid-liquid interface.

The temperature coefficient for the iodine-thiosulfate reaction, when the iodine concentration was greatly in excess of the thiosulfate concentration, was about 1.2, and when the thiosulfate was in great excess, it was about 1.1. This indicated that the reaction rate controlling mechanism was one of diffusion and not that of a chemical reaction. The effect of change of stirring rate on the reaction rate was quite pronounced, being substantially proportional to the change in reaction rate, and thus also indicating that the rate controlling factor is one of diffusion rather than a chemical reaction rate.

The overall distribution coefficient of iodine between bromobenzene and water was determined for a series of iodine concentrations in bromobenzene. A series of reaction rate measurements of the iodine-thiosulfate reaction was made using the same iodine concentrations in bromobenzene used in the distribution coefficient experiments, and a given, low thiosulfate concentration in the water layer. It was found, under these comparable conditions, that the reaction velocity of the iodine-thiosulfate reaction was directly proportional to the overall partition coefficient. Thus the relative solubility or distribution of iodine in the water phase, as compared to the bromobenzene phase under a given set of conditions, is a major reaction rate determining factor.

Reaction rate measurements also were made where the iodine was replaced in the bromobenzene layer by allyl bromide, phenacyl bromide and ethyl bromoacetate, respectively. In these heterogeneous systems, it was found that ethyl bromoacetate reacted more rapidly than the other two reactants, and that the speed of reaction of phenacyl bromide was the lowest of the three organic reactants. In homogeneous aqueous systems, on the other hand, phenacyl bromide is the most reactive and allyl bromide is the least reactive of these three reactants with thiosulfate ion. The relative order of the reaction speeds of the three reactants in the heterogeneous system coincided with the relative order of the overall partition coefficients of the reactants, thus indicating that the partition coefficients of the reactants in the heterogeneous system are greater factors in determining the measured reaction velocities than the respective reactivities in a homogeneous system.

The effect of temperature and rate of stirring on the heterogeneous reactions of the three organic reactants is similar to that described above in discussing the iodine reaction. The heterogeneous liquid-liquid reaction of iodine and the three organic reactants, taking place at the interface with thiosulfate, more nearly obeys a zero order reaction than a first order reaction in that the rate of reaction of the reactant kept at low relative concentration more nearly approaches proportionality with the concentration of the reactant than with the logarithm of the concentration. 204 pages. $2.55. Mic 56-1387

A KINETIC STUDY OF CRYSTALLIZATION IN POLY-(DECAMETHYLENE SEBACATE)

(Publication No. 16,256)

Alan David McIntyre, Ph.D.
Cornell University, 1956

An experimental technique is described which is suitable for the separate determination of homogeneous nucleation and growth rates of spherulites in supercooled polymer melts. Thin sections of the supercooled melt, previously freed of dust particles to ensure predominance of homogeneous nucleation, were observed under a polarizing microscope at degrees of supercooling in the range 8^0 to 12.9^0C. below the equilibrium melting temperature. The development of crystallinity was recorded photographically, the photographs being taken at convenient time intervals suitable for each degree of supercooling. With a knowledge of the sample volume, the number of spherulites appearing on successive photographs of the sample field was converted to number of spherulites per unit volume and a plot of this quantity against time yielded the rate of homogeneous nucleation. From a knowledge of the magnification factor of the optical system, the radius of a given spherulite was determined from its image on successive negatives. A plot of radius against time yielded the growth rate.

It was found that changes in molecular weight over the range $\overline{M}_n$ equal 5,300 to 10,300 were without effect on the kinetics of crystallization. In addition, a period of incubation, typical of the degree of supercooling, is indicated during which the growth rate of homogeneous spherulites is exceedingly low. It was found that spherulites nucleated homogeneously and heterogeneously exhibit the same linear growth rate.

Crystallization rates, calculated from the observed

nucleation and growth rates for poly-(decamethylene sebacate) at the temperatures studied, are compared to the crystallization rates observed for the same polymer with a conventional dilatometric technique. The comparison indicates that spherulite nucleation and growth affords a true measure of the crystallization phenomenon in supercooled polymer melts.

From calculations involving peak broadening in X-ray powder diagrams and interference maxima in low angle scattering patterns, crystallite dimensions were found to be of the order of 70 Angstroms. A comparison of this dimension with the critical size, defined according to nucleation theory by the crystallization temperature, indicates that crystallites grow two- to threefold beyond the critical size.

Since the observed spherulite growth rate exhibits a temperature coefficient of the same order of magnitude as that of the nucleation rate, it is postulated that spherulite growth proceeds by a mechanism controlled by secondary nucleation. The proposed mechanism is discussed from the points of view of thermodynamic considerations and information which is at present available concerning the polycrystalline morphology of polymers.

82 pages. $1.03. Mic 56-1388

ELECTROPHORETIC STUDY OF BOVINE PLASMA ALBUMIN

(Publication No. 16,206)

Bernard S. Schlessinger, Ph.D.
The University of Wisconsin, 1955

Supervisor: Associate Professor Robert A. Alberty

Mobilities in the pH range 1 - 11 for crystallized bovine plasma albumin at ionic strengths of 0.1, 0.05, and 0.01 and a protein concentration of 0.5 g/100 ml. were determined. The values of mobility at a given pH and ionic strength showed a marked dependence on the buffer used, although all the buffers were of the uni-univalent type. The influence of the temperature in the range 0 - 25°C on the pH measurement was found to be slight (maximum differences of 0.1 - 0.2 pH units) for buffers in the acidic range, but differences as large as 0.6 pH units were measured for buffers in the basic range.

The titration curves for bovine plasma albumin at ionic strengths of 0.1 and 0.01 and a protein concentration of 0.5 g/100 ml. were determined at 0°C. Both sodium perchlorate and sodium chloride were used to make up the ionic strength. The data indicate that perchlorate ion is bound more strongly than chloride ion by the albumin molecule, although the opposite might be expected from other types of experimental results.

The electrophoretic patterns in both the acidic and basic ranges showed evidence of heterogeneity of bovine plasma albumin, which substantiates the view that the protein might be separated into two or more components of very close mobility.

The comparisons of the mobility and titration data were made through the use of plots of mobility versus titration valence. The deviations from linearity of these plots indicate either a large increase in anion binding or a structural change in the albumin molecule resulting in an increased frictional coefficient in the acidic region. Two findings indicate that the observed effects must be at least partly due to a structural change in the molecule.

(a) Although perchlorate and chloride ions were found to be bound to varying extents by albumin, as indicated by the titration data, the slopes of the plots of mobility versus titration valence for the perchlorate and chloride data are the same.

(b) The effect of binding on the mobility would be expected to decrease as the ionic strength is decreased, but the deviations from linearity at 0.01 ionic strength are more pronounced than those at 0.1 ionic strength.

A structural change in the molecule resulting in an increased frictional coefficient in the acidic range is indicated also by the fact that the slope of the pH - mobility curve is the same at 0.01 and 0.1 ionic strengths, although an appreciable change in slope would be expected from the Henry equation. Assuming that there is increased anion binding at higher ionic strengths, the change in slope should be even greater than that predicted by use of the Henry equation, so that binding cannot serve as an explanation. A dependence of the frictional coefficient of the molecule on ionic strength is perhaps to be expected. The observed effect here was in the proper direction. At lower ionic strengths, the screening effect between any two like charges of the highly positively charged molecule would be decreased, resulting in a repulsive effect. This repulsive effect would lead to a swelling of the molecule and a resultant increase in the frictional coefficient.

In the basic range, exactly analogous effects to those in the acidic range were observed for the plots of mobility versus titration valence and for the pH mobility plots. They can be explained in the same manner.

An electrophoresis apparatus, equipped with an interchangeable cylindrical lens-schlieren optical system and Rayleigh interferometric optical system, capable of giving records of both the refractive index gradient and refractive index versus height in the cell is described.

91 pages. $1.14. Mic 56-1389

VAPORIZATION OF B_2O_3 AND OTHER GROUP THREE OXIDES

(Publication No. 16,212)

John Richard Soulen, Ph.D.
The University of Wisconsin, 1955

Supervisor: Assistant Professor J. L. Margrave

The vapor pressure of boric oxide has been measured by the flow technique in the pressure region 10^{-3} - 10^{-2} atm. Within the accuracy of the measurements agreement is obtained with effusion vapor pressure results of other workers at lower pressures. The highest temperature at which measurements were made in this work was 1886°K. In addition, the normal boiling point of boric oxide has been established as greater than 2400° K.

A spectroscopic study has been made of the so-called "boric acid fluctuation bands," which were found to be emitted by the vapor in equilibrium with liquid boric oxide at high temperatures. A number of wavelengths have been

measured, and observations have been made on the bands in absorption, it is believed for the first time. It is shown that $B_2O_3(g)$ is the molecule responsible for these bands, rather than BO(g) as has been suggested in the recent literature. The variation of intensity of the bands with temperature has been measured, and the value obtained in this manner for the heat of vaporization of borix oxide agreed well with that obtained from vapor pressure measurements.

From available thermodynamic data on boron, oxygen, and the oxides of boron, free energy functions have been tabulated at 100^0 intervals, and heats of formation have been compiled. The suboxides BO(g) and $B_2O_2(g)$ have been considered at length in order to determine whether they are of importance in the vaporization of boric oxide.

All evidence indicates that liquid boric oxide vaporizes predominantly as $B_2O_3(g)$ at all temperatures up to its boiling point. 192 pages. $2.40. Mic 56-1390

MOLECULAR WEIGHT AND STRUCTURAL CHARACTERISTICS OF SOME AMYLOPECTINS AND THEIR beta-AMYLASE LIMIT DEXTRINS

(Publication No. 16,492)

Carl J. Stacy, Ph.D.
Purdue University, 1956

Major Professor: Joseph F. Foster

Light scattering, flow birefringence, and intrinsic viscosity behavior were studied for several amylopectins and their limit dextrins, with particular emphasis upon the molecular weight and structural characteristics of corn amylopectin.

A detailed study of the angular and concentration dependence of scattered light from solutions of native corn amylopectin and its limit dextrin in one normal alkali, ethylenediamine, and ethylenediamine hydrate led to an average value of 80 million for the molecular weight of corn amylopectin and 29 million for corn limit dextrin. Good agreement was found for a given sample in the various solvents. It is concluded that the same degree of dispersion was attained in the various solvent systems as in the original dispersion during preparation, and is probably very nearly molecular. Since the ratio of molecular weights is very nearly that expected on the basis of the known degree of degradation by beta-amylase, it can be further concluded that the form of the molecular weight distribution of limit dextrin must be very nearly the same as that of the amylopectin.

The scattering envelopes for both polysaccharides in all solvent systems were the same shape and had only a slight upward curvature. This curve can only be the resultant of the known high degree of branching and heterogeneity.

The radii of gyration were in excellent agreement for both samples in the three solvents, average values for amylopectin and limit dextrin being 2090 and 1340Å. Thus the molecules are swollen to the same degree in the three solvents and it is reasonable to assume that the segments making up the limit dextrin have the same average square distance from the center of gravity as they have in the amylopectin molecule. Accepting this assumption and the similarity of the molecular weight distributions it is seen that most of the material must have been removed from points near the periphery. Consideration of various simple models using the above evidence reveals the fact that a sphere of uniform density losing 60% of its bulk leads to a decrease in the mean square radius of gyration less than that found above, and the situation is even less favorable for uniform ellipses of any axial ratio. A spherical distribution with a decreasing segment density with radius is in keeping with the data.

Intrinsic viscosities in one normal alkali are reported for the various materials. The decrease in intrinsic viscosity in the formation of the limit dextrin is very small. Attempts were made to find a θ-solvent in order to extend the viscosity work on a more quantitative basis, but were unsuccessful mainly due to the great tendency for precipitation of the material, probably in a solid semi-crystalline phase rather than a liquid-liquid equilibrium separation. It was found that the molecules are greatly swollen in ethylenediamine due to solvation and in alkali due partly to a charge effect.

The order of magnitude discrepancies in reported molecular weight values for amylopectin can be completely explained on the basis of a broad molecular weight distribution such as that predicted by Flory for A-R-B_2 condensation, though the distribution may vary in details. Using the weight average molecular weight a number average molecular weight of 162,000 can be calculated and is close to the experimental value 240,000 found by reducing value and osmotic pressure. The difference could easily be due to loss of the low molecular weight tail during preparation.

Heterogeneity and deformation effects prevent a quantitative interpretation of the flow birefringence data. In general it was found that the observed birefringence was less and the extinction angle greater for the limit dextrins, suggesting less deformation. The alternative assumption of particle anisotropy in the resting state is inconsistent with the interpretation of the light scattering results.

217 pages. $2.71. Mic 56-1391

THE HOLE THEORY OF THE LIQUID STATE

(Publication No. 16,494)

Donald Charles Stupegia, Ph.D.
Purdue University, 1956

Major Professor: Charles R. Mueller

Using the hole theory of the liquid state as a starting point, various modifications have been considered which would bring theory in agreement with experiment. Modifications of the free volume term were considered first, but in order to get satisfactory results for the critical constants, the prediction of the enthalpy of vaporization had to be sacrificed. To keep this enthalpy within reason, a change in the entropy is required. Two successful partition functions for the liquid have been found. The first of these is found in the equation which follows where j is the factor for internal motions, N_A and N_B are the number of molecules and holes, respectively, and w is the energy of vaporization of a molecule of A from pure crystalline A.

$$Q = \left(\frac{2\pi\, m\, kT}{h^2}\right)^{3N_A/2} j\, \frac{N_A\,(N_A + 7N_B)\,!}{N_A\,!\,(7N_B)\,!}\; x$$

$$\exp\left[\frac{N_A^2}{N_A + N_B}\,\frac{w}{kT} + \frac{N_A^2\, N_B^2}{12(N_A + N_B)^3}\left(\frac{w}{kT}\right)^2\right]$$

The reduced critical constants are $w/kT_c = 3.46$, $V_c/V^* = 3.322$, and $P_c\, V_c/RT_c = 0.326$, while the experimental averages for typical non-polar substances are, respectively, 4.5, 3.1, and 0.293. Here V^* is the volume of the pure crystal. This equation gives for the heat of vaporization a value of $-4.08\ RT_c$ while the experimental is $-5.21\ RT_c$. The slope of the rectilinear diameter is -0.95, and the experimental is -0.75. The densities of the coexisting phases are predicted fairly well. When extended to binary solutions, this equation predicts the quantities of mixing quite well, except for the volume change on mixing.

The second equation corresponds to what we consider to be a physical model containing roughly one-third sized holes. The Helmholtz free energy is

$$\frac{F - F^0}{kT} = N_A \beta n \frac{N_A}{N_A + N_B} + 3\frac{1}{3}\beta n \frac{N_B}{N_A + N_B}$$

$$+ \frac{N_A\, N_B}{N_A + N_B}\,\frac{w}{kT} - \frac{N_A^2\, N_B^2}{12(N_A + N_B)^3}\left(\frac{w}{kT}\right)^2,$$

where F^0 is the free energy in the standard state, where $N_B = 0$. The calculated reduced critical constants are $w/kT_c = 4.422$, $V_c/V = 3.952$, and $P_c\, V_c/RT_c = 0.317$. The calculated heat of mixing is now $-4.97\ RT_c$. A modified diameter plot (using density in the standard state instead of critical density) gives a slope of -2.03, while experimental is -2.25. Coexisting phase densities are calculated. The vapor phase agrees very well, and the liquid phase quite well, especially around room temperature. The mixing quantities of binary solutions are predicted better by the second equation than by the first.

118 pages. $1.48. Mic 56-1392

THERMAL DIFFUSION AND MOLECULAR MOTION

(Publication No. 16,432)

Louis Joseph Tichacek, Ph.D.
University of Illinois, 1956

The theoretical expression for the thermal diffusion ratio in a binary system is found by using the thermodynamics of irreversible processes to obtain the result

$$\alpha = \frac{\bar{V}_1\, \bar{V}_2}{\bar{V}\; x\; \frac{\partial \mu}{\partial x}}\left[\frac{Q_2'^*}{\bar{V}_2} - \frac{Q_1'^*}{\bar{V}_1}\right]$$

where α is the thermal diffusion ratio, $\bar{V}_1$ and $\bar{V}_2$ are the partial molar volumes of components 1 and 2 respectively, $\bar{V}$ is the molar volume of the solution, x the mole fraction of one component, μ the chemical potential, and $Q_1'^*$ is that part of the enthalpy of activation (for motion of a type 1 molecule) which is carried with a type 1 molecule as it moves through the solution. Empirically it is found that $Q_1'^*$ is equal to $\triangle H_{h_1}^{\ddagger}$, that part of the enthalpy of activation which is associated with formation of the activation or maneuver volume, $\triangle V_1^{\ddagger}$, for the type 1 molecule as it moves in the solution.

This particular thermodynamic treatment employs geometric (or laboratory) coordinates in its development instead of the center of mass coordinate system used by previous workers. The successful interpretation of Q'^* has resulted mainly from this new coordinate system; using this new information it is found that the significance of Q^* previously used by de Groot (1) and others is

$$Q^* = \bar{H}_1 - \bar{H}_2 + \frac{\bar{V}_1\, \bar{V}_2}{\bar{V}}\left[\frac{Q_2'^*}{\bar{V}_2} - \frac{Q_1'^*}{\bar{V}_1}\right]$$

where Q^* is the heat of transport in the center of mass coordinate system, $\bar{H}_1$ and $\bar{H}_2$ are partial molar enthalpies of components 1 and 2 respectively, and the $Q_1'^*$ is that defined in the first paragraph.

An expression for α of essentially the same form as that given above can be obtained by using a kinetic flux equation similar to that proposed by Prigogine (2), but by modifying the equation to account for the difference in the sizes of the molecules involved.

By using for $Q_1'^*$ and $Q_2'^*$ the values of $\triangle H_{h_1}^{\ddagger}$ and $\triangle H_{h_2}^{\ddagger}$ or approximations thereto, the direction of separation can be predicted correctly for all known systems and the magnitudes of the separations can be predicted almost quantitatively for the majority of systems.

The necessity of $x\frac{\partial \mu}{\partial x}$ in the denominator of the expression for α is shown by thermal diffusion measurements on systems for which $x\frac{\partial \mu}{\partial x}$ is very small -- i.e., a mixture near its critical solution region, and also highly non-ideal mixtures involving methanol.

REFERENCES

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2. Prigogine, I., de Broukere, L., and Amand, R., Physica, 16, 577 and 851 (1950).

119 pages. $1.49. Mic 56-1393

THE HEAT CAPACITY OF GASES AT LOW PRESSURE USING A WIRE-RIBBON METHOD

(Publication No. 16,498)

William Nicholas Vanderkooi, Ph.D.
Purdue University, 1956

Major Professor: Thomas De Vries

A wire-ribbon method was developed for the simultaneous determination of the thermal accomodation coefficients and heat capacities of gases in the micron of mercury pressure region. Equations were derived which relate the derivatives of the power dissipations of the wire and ribbon with respect to pressure at constant temperature to the heat capacity of the gas at constant volume and its thermal accomodation coefficient.

The power dissipations of a platinium wire and ribbon, suspended parallel to each other at a distance of two millimeters, were determined as functions of pressure when their temperatures were 26° and 36°C, respectively, in the presence of gases at 25°C. Using argon as a reference gas of known heat capacity, the equations for the power dissipation derivatives for the wire and ribbon were solved simultaneously to obtain the heat capacities and accomodation coefficients of several gases. The accommodation coefficients of argon and helium on shiny platinium were found to be 0.907 and 0.36, respectively; and those of trifluoromethane, monochlorotrifluoromethane, and 1,1,1-trifluoroethane were obtained as 0.888, 0.885, and 1.00, respectively. The heat capacities at constant volume and 300°K were calculated from the experimental data as 10.23 ± .04, 14.10 ± .13, and 16.83 ± .02 cal/mole/deg for CHF_3, $CClF_3$ and CF_3CH_3, respectively. Since the measurements were made at pressures sufficiently low to cause the gases to behave ideally, the heat capacities are equal to those of the gases in their standard state.

Using tables giving vibrational contributions to the heat capacity and published vibrational frequencies for CHF_3, $CClF_3$ and CF_3CH_3, their heat capacities were calculated to be: 10.25; 14.02 and 14.06; and 14.71 and 14.72 cal/mole/deg for all degrees of freedom except that of internal rotation. For CF_3CH_3 the difference of 2.115 cal/mole/deg between the experimental and spectroscopic values is the contribution to the heat capacity of the torsional vibration, or the hindered internal rotation, of the two methyl groups with respect to each other. From this difference the potential barrier hindering free internal rotation was estimated to be 3.4 kcal/mole which agrees within experimental error with other published values.

The results of this investigation have shown that with careful attention to details the wire-ribbon method gives accurate heat capacity values which can be used directly with spectroscopic data to verify the assignments of vibrational frequencies and to estimate potential barriers hindering internal rotation.

269 pages. $3.36. Mic 56-1394

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

ECONOMICS, GENERAL

A CASE ANALYSIS OF SUITABLE WORK DISQUALIFICATIONS IN UNEMPLOYMENT INSURANCE LAWS

(Publication No. 16,250)

Robert William Carney, Ph.D.
Cornell University, 1956

This study deals with the administration and the interpretation of the suitable work clause found in state unemployment insurance laws. Claimants may be disqualified and denied benefits if they fail to accept suitable work. The purpose of this study is to examine critically the case decisions pertaining to suitable work disqualifications to ascertain what uniformity exists in the interpretation of similar fact situations between states and within a given state. A further purpose of the study is to build empirically from the cases examined, a definition of suitable work.

The Federal Bureau of Employment Security has published thousands of benefit cases under the title Unemployment Compensation Interpretation Service, Benefit Series. In addition, the New York State School of Industrial and Labor Relations, has become the depository for the benefit cases of the fifty-one jurisdictions after they have been held by the Federal Bureau for three years. The author had for examination practically all of the suitable work cases that have been appealed since unemployment insurance laws were first enacted in this country. Over five thousand of these cases were analyzed.

The analysis of the case decisions discloses that it is impossible to define suitable work in the abstract. First of all, the statutory provisions relating to suitable work are in broad and general terms. Secondly, certain deficiencies are apparent in the written decisions frequently indicating a poor organization of the facts of the case, the decision, and the reasons therefore. Hundreds of cases were rejected because of these deficiencies. In twenty years of operation of our unemployment insurance laws, only a small number of different factual situations have been appealed to the courts and these decisions have been groping in terms of establishing policy. And finally, there has been a lack of uniformity in decisions growing out of similar factual situations. However, over the years supplemental standards to the statutory standards have grown out of the case decisions, but these have also been general in nature, and do not give us any uniformity of application in decisions making. They may be applied in a certain way for one type of factual situation and in another way for a different type of factual situation or two different standards may be used to arrive at a decision in similar factual situations. This is true not only among the different states but also within a given state over a period of time and between different personnel administering the laws. The implication is that the social and economic background and the personality of the administrator has a great effect on what the decision will be.

It would seem advisable that general standards should be maintained so as to permit the needed flexibility to decide cases with regard to the claimant's length of unemployment, and with regard to the changing labor market conditions. However, whether personal hardship, and domestic circumstances, and other factors pointed out in the body of the study, are to be held as good cause for refusing work should not depend upon such factors as the condition of the labor market. It is recommended that federal legislation be enacted to expand the areas of "good cause" for refusing employment. In addition, the decisions indicate a necessity for bringing a greater degree of objectivity into the administering of the disqualification provisions of the unemployment insurance law. Clarifying the standards and goals should help to achieve this objectivity but perhaps a program of better selectivity and training of those responsible for administering the benefit provisions of the law is also needed. 450 pages. $5.63. Mic 56-1395

THE ACTIVITIES OF THE INTERNATIONAL LADIES' GARMENT WORKERS' UNION IN OKLAHOMA

(Publication No. 16,328)

Philip Lewis Howell, Ph.D.
University of Pennsylvania, 1956

Supervisor: Paul F. Gemmill

A description of the activities of the International Ladies' Garment Workers' Union in the state of Oklahoma; the organizational problems confronting the union; the tactics employed to solve these problems; and the degree of success achieved by the union.

The study covers the period 1943 through 1955. Specific topics dealt with include: Choosing sites of union activities; chartering of locals; community and worker attitudes toward the union, including the attitudes of local businessmen, public officials, and press and radio; selection and training of union representatives and Regional Office control over representatives; union conduct of organizational campaigns, including contacting workers, appeals to workers, methods of exerting economic pressure on employers, and community relations; relations between union locals and the Regional Office of the union; the educational program of the union; anti-union tactics of employers; labor-management relations; conduct of contract negotiations; contract provisions; union relations with the National Labor Relations Board; and a detailed description of the one (prolonged) strike conducted by the union in the state.

The study is drawn largely from unpublished material in the files of the union's Regional Office. Special reliance

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

has been placed on the correspondence between the union's representatives (organizers) and the Regional Director. Use has also been made of correspondence between the Regional Office and union attorneys. Other sources include: Union correspondence with the NLRB; the files of local newspapers; personal interviews with union and management representatives; interviews with local businessmen, public officials, etc.

The success of the union is found to have been limited. Possible errors in tactics are indicated and tactical changes are suggested. The union is held, however, to have been confronted with a formidable combination of obstacles to successful organization. These obstacles include: The terms of plant construction; active opposition by local businessmen; passive opposition on the part of the general public; a lack of unionism in the various communities; a lack of alternative employment opportunities for women garment-shop operators, particularly in occupations covered by the federal minimum-wage law; and the fear, lack of patience, and ignorance of unions which characterize the employee group. These obstacles are considered the principal causes of the union's limited achievements.

The union's prospects for substantial organizational success in Oklahoma in the immediate future are considered not bright. 298 pages. $3.73. Mic 56-1396

CLIMATIC ADAPTATION AND ECONOMIC POSSIBILITIES OF SUGAR PRODUCTION IN IRAN

(Publication No. 16,420)

Javad Pirouzbakht, Ph.D.
University of Illinois, 1956

The general objectives of this study are to evaluate the natural and economic advantages of Iran in the production of sugar, and to outline a system of sugar production that would make the best use of available natural resources, labor and capital.

The analytical part of the study is based on economic principles and on technological information, particularly regarding sugar beet production. Interregional competition and location of sugar production are analyzed within the framework of the principle of comparative advantage. The related economic concepts of complementary, supplementary, and competitive relationships are the basis of studying the productive use of resources of the individual farmer and of the sugar industry of Iran.

The important technological analysis involves a study of climatic factors and their influence on sugar beet production. This analysis shows that in temperate zones, areas with long growing seasons and dry climate have a natural advantage in production of beets. Most economical sugar beet production must conform to two kinds of climatic adaptation: (1) locational adaptation, which means that location of sugar beet production be selected from areas naturally endowed with climatic elements favorable to production of sugar beets; and (2) seasonal adaptation, which means that length of growing season should permit optimum combination of controllable factors (cropping practices) with uncontrollable factors of production (climate).

From application of the technological analysis to the Iranian situation it is concluded that the climate of Iran is well suited to production of sugar beets. Large areas in Iran have a long growing season, dry climate, and bright sunlight which is another important factor in sugar beet production. The most characteristic physical feature of Iran is a rapid change in altitude in short distances, and resulting changes in temperatures, length of growing season, and distribution of rainfall. This situation provides unique opportunities for the seasonal adaptation of sugar beet production. Within relatively short distances beets can be grown as a summer crop in short growing season areas, and as a winter crop in long growing season areas. In long growing season areas farmers have a particular advantage in being able to produce beets as a supplementary crop. In this way they could make full use of their available resources of water, the most scarce resource, and labor.

The possibility of seasonal adaptation of beet production in the Iranian situation suggests an important criterion for selection of a sugar factory location. The plant should be located where it can process beets from different areas producing and harvesting beets at different seasons of the year. In this way the operating period of the factory can be greatly extended, and the factory can take advantage of large-scale economies and full use of facilities and labor.

As a model the possibilities of seasonal adaptation are applied to the Marv-Dasht factory area. This example shows that long and short growing season areas would not be competitors in the use of factory resources, and that the processing period could be extended from five to ten or more months. The volume of beets necessary for such a long processing period could be produced within a distance from the factory that would be economical from the standpoint of transportation costs.

The problem of markets is a difficult one in Iran. It is a large country with a small population. Transportation is not well developed and there are no large city markets for varied products. A sugar factory, however, brings even to remote villages a market equivalent to a large city. This greatly increases the productive use of resources in these villages that would otherwise be idle.

This study is concerned mainly with production of sugar beets. The possibilities of growing sugar cane in southern coastal areas is considered only briefly. The land is fertile and suited to mechanization, and irrigation water is available. Sugar cane could be an important crop in solving the problem of what to produce with water from irrigation projects being developed in these areas.

172 pages. $2.15. Mic 56-1397

THE NATIONAL ASSOCIATION OF RAILROAD AND UTILITY COMMISSIONERS AS THE ORIGINATORS AND PROMOTERS OF PUBLIC POLICY FOR PUBLIC UTILITIES

(Publication No. 16,211)

Edward Walter Smykay, Ph.D.
The University of Wisconsin, 1956

The National Association of Railroad and Utility Commissioners was organized as a national group in the year

1889. Although groups of state commissioners had met to discuss their problems before that date, it was not until the Chairman of the Interstate Commerce Commission, Thomas M. Cooley, issued a call for a convention that national organization was achieved.

The membership of the Association has always consisted of state and federal commissioners and their staff members. Although formal membership was limited to these groups, representatives of management, consumer, and shipper interests attended as observers and guest speakers at the annual meetings.

Functionally, the Association was organized to discuss problems of regulation and to make recommendations for the solution of these problems. With the passage of time, the actions and activities of the NARUC changed as the problems of regulation changed. As any living organism, the continuation of its existence depended on its adaptability to a changing environment.

The first level of activities of this institution was focused on the broad issues of public policy. Of primary importance in this area is the problem of jurisdiction. In the early stages the issue of jurisdiction revolved around the proper establishment of it. Later the problem of relative jurisdiction arose as the federal commissions extended their power and authority.

The second level of activities is related to the perfection of the devices and tools which would effectuate the exercise of jurisdiction. Illustrations on this level are valuation, accounting, rate research, and related items. These are the technical instruments through which practical regulation may be achieved.

The third level of activities related to the development of standards for the proper operation of the public utility enterprise in the public interest according to the decisions and actions of the regulatory authorities. Particularly, the establishment of standards of operation to determine the relative efficiency of the firms in the industry fall into this category. Such things as the standard number of BTU's in a given volume of gas, the collection of data on car service and demurrage for railroads, and the nature of the demand for electricity by different classes of customers are illustrations of this function.

Obviously this is a broad program of objectives. The question then may be asked as to what influence the NARUC had on the final expression of public policy for public utilities.

By this standard the NARUC must be judged as a positive and useful institution which has made worthwhile contributions to the development of regulatory theory, policy, and practice. In the absence of this association of men charged with the public responsibility of regulating a certain segment of the economy for the common good, there would be one less institution dedicated to the creation of society of good order. In a society where the institutions that stand between the individual and his inherent rights on the one hand and the general authority on the other are non existent, the alternatives have normally been either extreme individualism or dictatorship. To anyone dedicated to that happy balance between rank individualism and dictatorship the NARUC stands as an example of that type of intermediary institution that results in a well-ordered society. 443 pages. $5.54. Mic 56-1398

ECONOMICS, COMMERCE - BUSINESS

CONSUMER INFORMATION CHANNELS

(Publication No. 16,325)

George Fisk, Ph.D.
University of Pennsylvania, 1956

Supervisor: R. Cox

I. Problem

This is an analysis of a pilot study conducted among 595 meal planners during September, 1954 in Norristown, Pennsylvania. Its purpose is to describe how they learned about new food products. It is also a pilot test of certain methods of obtaining these data.

II. Method

Meal planners in a block cluster sample of dwelling units were interviewed by trained field interviewers. Results were analyzed by single item and scaling techniques.

III. Findings

A. Personal Searching.

1. The more food stores visited the higher the probability that buying advice is sought from store personnel.
2. Most meal planners make at least one shopping trip a week, but deliberate advice-seeking is a more limited activity.

B. Social Groups.

1. More organization members discuss food buying in informal groups than do non-members.
2. Absence of cluster patterns of informal group communication cannot be taken to mean that reference groups are not influencing consumer behavior. Reference groups in food buying are based on kinship more often than on propinquity.
3. Most meal planners get new recipe or product ideas from relatives who live outside their immediate neighborhoods.

C. Communication Patterns.

1. Acceptance of innovation is related to the propensity to communicate. The more personal searching and social group channels a meal planner is exposed to the higher the probability of purchase or learning of a new product.
2. The propensity to communicate is demonstrated by a unidimensional scale of communication activities in personal searching and social groups.
3. The propensity to seek information is related to preferences for information media. Minimal communicators prefer direct personal experience more often than others, while maximal communicators tend to prefer magazines and formal social organizations.

4. The propensity to seek information is highest among upper status and 17-to-35-year-old respondents, while the market isolates are more numerous among those 56 and over or in the lower-middle or lower social status categories.

D. Media Exposure and Impact.

1. Media exposure and impact give evidence of the modifying influence of reference groups on individual behavior.
2. Most introductions to new products are through store shelves or freezers. TV and relatives appear to be the most frequently mentioned mass media and social group sources.
3. The impact of social contacts upon persons who learn of products they have not bought is greater than the impact of mass media, but personal searching commands the widest audiences and makes the deepest impact upon persons who actually bought a product for the first time in the interviewing period.

E. Social Functions of Information Media.

1. The media meal planners find most helpful in establishing a frame of reference for appraising new products appear to be related to past experience.
2. Personal searching provides the least effort means of learning about new products by persons who have difficulty in making abstractions required by word and picture symbols.
3. Mass media increase the range of alternative product choices by means of word-of-mouth and personal searching sources. It broadens the perspective of consumers by teaching them about goods they may subsequently decide they do not want.
4. Social groups may extend consumer sovereignty. By passing on the merits of innovations, consumers can multiply and accelerate transmission of information about both satisfactory and unsatisfactory new products.

IV. Conclusions

Analysis of communication propensities of audiences upon whom sellers hope to have an effect by transmitting information would contribute to a clearer understanding of the costs of reaching customers.

Six areas in which communication research designs may be improved include: Learning about and buying new products; the propensity to communicate; the influence of individual capacities and interests in personal searching; the influence of reference groups; media impact; and sociodemographic characteristics associated with the five preceding attitudes and behaviors.

202 pages. $2.53. Mic 56-1399

MERCHANDISING FRYERS IN SELF-SERVICE SUPERMARKETS

(Publication No. 15,597)

Thomas Iver Gunn, Ph.D.
Cornell University, 1955

This study was designed to measure the effect of various merchandising practices on the volume of fryer sales in self-service supermarkets. It was a follow-up of a fryer merchandising study conducted in five supermarkets with service-type meat departments in the fall of 1953.

Data were collected over a four-month period from September 13, 1954 to January 22, 1955. Controlled experiments of a latin-square rotational design were used in collecting information for the first three experiments. An opinion survey and a matched-lot controlled test were used in gathering data for the last experiment.

Table 1. EFFECT OF VARIOUS MERCHANDISING PRACTICES ON FRYER SALES

Four Central New York Supermarkets
September 13-December 18, 1954*

Merchandising practices	Fryer sales per 100 customers: Average	Per cent of standard
Experiment One:	Pounds-frozen	
a: Standard. Frozen fryers in regular location.	0.9	100
b: Standard plus fresh and frozen fryers displayed side-by-side.	1.2	133
c: Neat arrangement of all frozen poultry in same frozen food case.	0.9	100
d: Fresh and frozen fryers only in fresh display.	0.6	67
Experiment Two:	Pounds-fresh	
a: Standard. Not in store advertising.	8.7	100
b: Simple window and point-of-sale advertising.	11.7	134
c: "Boatload of Chicken" combined with window advertising.	19.7	226
d: Window advertising with a special tie-in biscuit sale.	11.7	134
Experiment Three:		
a: Standard. Display of single packs and fryer parts.	10.2	100
b: Standard plus "Special Packs", a cut-up fryer-and-a-half.	14.7	144
c: Standard plus "Twin Packs", two cut-up fryers.	13.5	132
d: Standard plus "Special Packs" and "Twin Packs".	16.1	158

* Week of November 22-27 not included.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

The results of the First Experiment showed the importance of displaying frozen fryers with related products (Table 1). Sales increased 33 per cent when frozen fryers were offered both in a frozen food case and in the fresh poultry section of the meat department. The statistical analysis of the experiment revealed that this merchandising practice was significantly different at the 5 per cent level from the usual store practice of selling frozen fryers in their regular location.

A mass display of fryers, featuring a "Boatload of Chicken" combined with window advertising, was the most effective promotional practice in Experiment Two (Table 1). Fryer sales were 126 per cent greater than those from the regular store practice of selling fryers without advertising and promotion. The statistical analysis of the experiment showed that this merchandising practice was significantly different at the 5 per cent level from the other three practices tested.

A substantial increase in sales was obtained when customers were given a wider selection when purchasing fryers in Experiment Three (Table 1). Displaying prepackaged fryer parts as well as packages with one, one-and-a-half, and two cut-up fryers increased sales 58 per cent over the usual store practice of offering only single packs and parts. A sizeable increase in fryers sales also resulted when either "Special Packs", a fryer-and-a-half, or "Twin Packs" were added to typical supermarket fryer displays.

The results of the last experiment indicated that the color of poultry trays was not important to customers making fryer purchases. An opinion survey revealed that white trays were preferred by over 40 per cent of the customers. However, this indicated preference was not shown when fryers were packaged in white, peach, and green trays and then placed side-by-side in a fryer display. Sales of the packages failed to indicate customers had a poultry tray color preference. Observations at the display revealed that the trays, containing a fresh fryer overwrapped with cellophane, were not visible to customers making purchases.

The importance of an attractive fryer display is shown by customer observations during Experiment One. Most of the fryer purchases were made after shoppers studied and handled the packages in the display. This suggests to retailers the necessity of always offering customers high-quality poultry in eye-appealing packages. The absence of shopping lists among store customers also indicates the need for a good display. The selection of a frying chicken by a housewife might well be an impulse purchase based upon the attractiveness of the packages in a neatly arranged poultry display. 91 pages. $1.14. Mic 56-643

AN ANALYSIS OF INFORMATION STRUCTURE FOR THE INDUSTRIAL MANUFACTURING FIRM

(Publication No. 16,339)

Adrian Martin McDonough, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Robert P. Brecht

Statement of Problem

The research of the study has had as its basic aim the revision of certain aspects of contemporary organization theory. Whereas organization theory has generally considered information separately for each particular function or activity, this study reverses the approach, sets forth a general information structure--and then relates the function or activities to the entire information structure. To obtain this result it has been necessary to take a very broad view of business information, and to narrow down gradually to a specific set of factors most pertinent to information analysis for a given firm.

Thus, the basic problem of the study may be stated as follows: Is it possible, considering the many points of entry, to isolate the more significant elements which influence business information? Furthermore, is it possible to bring these factors together in an analytical system which can be used to study the integrated information needs of an industrial manufacturing firm?

The Approach Used

The study is presented in four parts:

Part I was used to survey the contributions of various groups studying information. It shows how these separated efforts can be brought together in the context of the business environment.

Part II was devoted to the development of an integrated structure of business information and an analysis of certain selected problems of information. Many of the factors influencing information are presented in conceptual diagrams using symbolism to make the more important relationships stand out for analysis purposes. The problems considered were:

1. What influence does the desire of a society for increased productivity have upon the demand for business information?
2. Can an information framework be developed to be used by general management to support a positive attitude toward managerial improvements?
3. Can a special classification system be devised which will act as an operational definition of the content of the field of industrial management?
4. What techniques are available to management in the solution of problems covered by the above special classification system?
5. Inasmuch as no organization can be equipped to study all its problems simultaneously, is there an approach which can be used to rank problems and schedule them for administrative attention?
6. Can a model be developed that emphasizes the structural aspects of procurement, production and distribution as tied to the physical handling of materials used in the business?

7. Can a model be developed that covers the static aspects of organization arrangements for handling recurring problems?
8. Can a model be developed that explains the kinetic nature of information?
9. What factors influence the individual as a receiver and as a source of information?
10. Can a model be developed which emphasizes integrated organization structure from the point of view of job information requirements?
11. Can the above factors be tied together to give a general framework for the analysis of business information?

These questions and their answers were developed into a generalized business information structure.

Part III covers the application of tests of the preceding analysis. Results of studies are given covering information analysis in the automobile, electronics, aircraft and public utilities industries.

Part IV completes the study with a summary of the strengths and weaknesses of the approach.

Findings of the Study

The major conclusions of the study were as follows:

1) Over one-fifth of our labor force is used to process the information needs of our economy.
2) Information needs of business management are increasing in both breadth and depth.
3) Managements are actively seeking analytical tools to help them handle masses of information.
4) The field studies demonstrated that information structural models aided managements in relating job information needs to organization responsibilities.

309 pages. $3.86. Mic 56-1400

COMPULSORY TEMPORARY DISABILITY INSURANCE IN THE UNITED STATES

(Publication No. 16,341)

Grant M. Osborn, Ph.D.
University of Pennsylvania, 1956

Supervisor: C. A. Kulp

Statement of the Problem.

Compulsory temporary disability insurance, providing benefits for temporary non-occupational disability, is the most recent of major developments in American social insurance. Interest in this field has stimulated considerable discussion. Partisan groups have not hesitated to present their respective viewpoints, but no impartial, comprehensive studies have been published. Very few studies of any kind have been undertaken in this field during the past few years.

In addition to presenting an impartial analysis of the various compulsory temporary disability insurance programs, this study attempts to determine the feasibility of this insurance in the United States.

Method.

The paucity of written material necessitated extensive use of the personal interview. The author interviewed administrative officials of each of the temporary disability programs (Rhode Island, California, New Jersey, New York, and the railroad program), as well as insurance company executives, leaders of labor and industry, research economists, and others interested in this insurance.

The method used is to analyze problems which have arisen in the temporary disability insurance programs in this country. For the purpose of this study, problems have been classified as they pertain to coverage, benefits, finance and administration.

This study is divided into three sections: (1) the first four chapters provide background, (2) chapters five and six briefly describe the statutes, and (3) the last four chapters present the problem analysis.

Results.

The primary results achieved by this study are:

1. A comprehensive analysis of the four state temporary disability insurance programs is presented, with emphasis upon the problems which have arisen.
2. The pros and cons and suggested solutions of these problems are discussed.
3. New data on the extent and duration of temporary non-occupational disability are highlighted.
4. The historical chapters emphasize the factors which have influenced the legislative developments.
5. The achievements of the different state funds are compared with each other, and in turn are compared with those of commercial insurance carriers.
6. Considerable unpublished data from commercial insurance operations in this field are presented.

Conclusions.

Most of the conclusions of this study pertain to the specific problems analyzed. It is hoped that these analyses will be of interest and use to those active in the field, and that perhaps the study may serve as a guide to study commissions appointed to consider temporary disability insurance legislation.

The continued operation of some of these programs for well over a decade, and the more than ten million workers being provided needed protection against an important hazard help to prove the feasibility of this insurance. The ability of the commercial insurance carriers to thus far successfully compete in this field indicates that they will play an important part in any future developments.

310 pages. $3.88. Mic 56-1401

CREDIT INSURANCE FROM THE POLICYHOLDER'S POINT OF VIEW

(Publication No. 16,099)

James Gordon Sheehan, Ph.D.
The Ohio State University, 1955

The purpose of this study is to evaluate credit insurance, i.e., the indemnifying of accounts receivable of manufacturers, wholesalers, and advertising agencies. The insurance is investigated from the viewpoint of the policyholder, to determine whether or not it is a desirable

means of transferring the risk of excessive bad-debt losses. More specifically, it is intended to show why three thousand American firms pay an average annual premium of about $2,300 to insure, why others have discontinued the insurance at a lapse rate of about fifteen per cent per annum, and why the vast majority of firms have declined even to try this tool of credit management.

Data were obtained by personal interview from executives of all known policyholder and past policyholder firms in the area of southwestern Ohio, in which the leading city, Cincinnati, is noted for diversified industry. Five hundred questionnaires were sent to credit managers and a like number to presidents of firms which were considered to be the most likely prospects for credit insurance in the region of concentrated investigation. Further study was conducted at the home offices of the only two American underwriters of credit insurance and at the offices of the New York State Insurance Department, which is charged with regulating those two insurers who file rates jointly.

The present policyholders interviewed reported that they insured receivables for the same reason that they carried fire insurance, while the major reason for insuring originally ascribed by former policyholders was the salesmanship of agents. These answers generally reflected confusion or lack of comprehension about credit insurance.

The main reason for discontinuance of policies by former policyholders queried was that credit insurance was just an added expense of doing business. However, among those who had experienced policy adjustment, the predominant cause of policy lapse was dissatisfaction with the adjustment procedure. The reasons for discontinuance of policies were more specific and indicated factual analyses.

Response was obtained from forty per cent of the firms receiving questionnaires. A majority of responding credit managers and presidents stated that their firms had no need for credit insurance, and nearly a fourth of them replied that the insurance was too expensive. Insurers find these answers important because businessmen act upon them.

As an example of credit insurance adjustment, in one case found an insured with losses of over $80,000 recovered less than $6,000. Credit insurance is so complicated that the only reasonable gauge of its cost to insureds is the loss ratio, which, for all known policyholder experience in southwestern Ohio, has been about twelve and a half per cent.

It is concluded that the great majority of firms truly have no need for credit insurance on all their accounts, as it is generally written today. It is further believed that most policies in force have resulted from the sales-persuasion of executives who do not adequately understand what they have bought and the tendency to confuse credit insurance with fire insurance. Most firms need fire insurance because they have only one structure or but a few buildings. Yet they have self-insurance in accounts receivable, because the risk is spread among hundreds or thousands of accounts. Credit insurance, however, does provide relief from credit worries for many, even though this psychological advantage often turns to disappointment as policy techniques are brought to light by adjustments or other incidents.

Notwithstanding, there is need for single-debtor insurance coverage at reasonable rates, so that businesses in weak working-capital positions could transfer the risks of one or a few relatively large accounts. Yet present high profits of insurers from small volume suggest that only effective competition in the field would cause noteworthy improvements along these lines.

266 pages. $3.33. Mic 56-1402

ECONOMICS, FINANCE

MONETARY POLICY IN CONTINENTAL WESTERN EUROPE, 1944-1952

(Publication No. 16,209)

Stephen Francis Sherwin, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Walter A. Morton

In the post World War II period, monetary policy in Western Europe was primarily concerned with combating inflation. In 1944-45 the monetary situations in Belgium, Denmark, France, Germany, Italy, and the Netherlands were strikingly similar. Each country had financed the war by printing notes, and the rigorous enforcement of price controls had kept price rises to relatively small proportions. Hence, these countries were faced with excess liquidity and repressed inflation. A reduction of the money supply was called for to prevent open inflation and to permit an orderly process of reconstruction.

Belgium and Holland reduced excess liquidity through currency reforms, which consisted of the outright cancellation and temporary blocking of the money supply. They were thus spared from open inflation. France and Italy failed to reduce liquidity, and were consequently beset by a price-wage spiral. In Germany inflation was repressed to such an extent that money lost its normal functions and the economy lapsed into a state of barter. Three years elapsed before a currency reform eliminated excess liquidity and restored a credit economy. Only Denmark was able to avoid inflation without reducing the money supply, primarily because its excess liquidity was relatively small.

The postwar reconstruction brought new inflationary pressures to all countries. In some, these pressures were aggravated by cheap money policies which gave rise to inflationary expectations and an unwillingness to purchase debt securities. Hence, the government deficits could only be financed by sale of securities to the banking system, which, of course, increased the money supply and thereby inflationary pressures. In other countries, where the government budgets were balanced or the public invested its savings in government securities, inflationary pressures were contained through dear money policies and quantitative credit controls. Qualitative credit controls were generally a failure, unless accompanied by price and wage controls, and these were successful in curbing inflation only when supplemented by restrictive monetary or fiscal policies.

By the end of 1948 production had reached pre-war levels, and inflation had been arrested in all countries. A majority, however, still had deficits in their balance of

payments. In countries such as Belgium, France, Germany, and Italy, which had relied primarily on monetary policy during the reconstruction, inflation was followed by a recession. No attempts were made to overcome the recession by expansionary monetary policy, because of the fear of renewed inflation and the persistent deficits in the balance of payments; the mere lowering of interest rates and an ample supply of commercial credit were insufficient to stimulate economic activity. In contrast, Denmark and Holland, whose economic policies during the reconstruction had centered on direct controls, were able to avoid a recession.

The outbreak of the Korean war in June, 1950, found Western Europe in the midst of a non-inflationary upsurge of economic activity and on the way toward balancing its foreign accounts. Faced with world-wide inflationary pressures, all countries experienced renewed price rises and balance of payments difficulties, because neither large increases in production nor a reduction of the money supply could offset the rise in velocity caused by inflationary expectations. After international raw material prices fell in the spring of 1951, inflation was arrested through credit controls in all countries. However, the balance of payments was brought into equilibrium only where restrictive monetary and fiscal policies were pursued, as in Belgium, Denmark, Germany, and Holland. Where the foreign accounts were not balanced, as in France and Italy, uneasy price stability continued, and the danger of renewed inflation imposed severe limitations on their attempts to raise standards of living through domestic investment programs.

579 pages. $7.24. Mic 56-1403

PUBLIC IMPROVEMENT FINANCING BY THE STATE OF MAINE

(Publication No. 16,347)

Richard Kenneth Stuart, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Alfred G. Buehler

This study has sought to determine the facts of public improvement financing in the State of Maine during the first half of the twentieth century. In conformity with the normative nature of public finance, the following principles have been set up: (1) the ultimate goal of capital outlays should be maximum benefit, or welfare, of the whole state; (2) capital improvements should be planned well in advance of construction; (3) capital improvement financing should contribute to economic stability, whenever possible; (4) capital improvements should contribute to economic growth, if possible. These are pragmatic principles which have emerged from the practical experience of municipal and state financial administration.

Public improvements are classified as (a) non-highway (schools, jails, hospitals, etc.), (b) highways and bridges, and (c) self-liquidating projects. Following a description of the State's revenue system, financial administration, and budget system, the history of each of these types of improvements has been presented in order to appraise them in the light of the principles of public improvement financing.

The only true long-range planning has been for highways and bridges. This planning has been separate from the regular State budget system. Thus, Maine has actually used an informal capital budget for highways and bridges. Periodic highway bond issues have dominated the State's bonded indebtedness.

In contrast to highways and bridges, there has been little long-range planning for non-highway improvements. Outlays for these have come primarily from unappropriated surplus funds or from current tax revenues.

Self-liquidating projects (toll bridges and the Turnpike) have been financed by revenue bonds. All but one project has been financially successful.

On only one occasion was public improvement financing planned for counter-cyclical effects; a bond issue in 1937. There has been much lip-service paid to the principle of pay-as-you-go finance. A tendency to apply this principle to non-highway improvements had left the State with widely recognized inadequacies in its institutions at mid-century. Highway financing during and immediately following World War II had similar results.

It is suggested, in conclusion, that the State should set up a "capital improvement committee" and adopt a six-year capital budget, co-ordinated with the ordinary biennial budget. Such a committee is necessary to plan improvements and to determine priorities in advance of construction. Then it will be possible to reconcile the goals of economic stability and economic growth.

283 pages. $3.54. Mic 56-1404

ECONOMICS, LABOR

TECHNICIANS IN INDUSTRY: A MANPOWER STUDY OF SEMIPROFESSIONAL OCCUPATIONS

(Publication No. 16,353)

Howard Rosen, Ph.D.
The American University, 1956

A study has been made of some relatively new semiprofessional occupations in the industrial labor force. These jobs, which appear to be developing in the occupational structure between the professional level and the skilled trades, are collectively called, "technician" jobs. Some of the job titles of these workers who can apply manual skills and training in mathematics and science to complex industrial problems are: engineering aids, laboratory technicians, and electronic technicians.

The growth of the semiprofessional occupations appear to be generated by the same factors creating a greater need for chemists and engineers in industry. The increasing complexity of products and manufacturing methods, and the concentration on research and development, are stimulating the demand for semiprofessional workers who can assist and support professional workers.

A study of semiprofessional occupations is warranted because a nation's technical labor force represents one of the basic elements of economic strength. The long-run and short-run aspect of technicians in the labor force was studied. An analysis was made to determine whether a

permanent change in manpower requirements was developing at the semiprofessional level. For the short-run problem, a study was made of the suggestions of management experts and professional societies that the use of technicians as supporting personnel will extend the short supply of professional workers.

Trade journals, recent manpower studies of professional and semiprofessional employment by the Government, Census data, reports of professional societies, and correspondence with persons directly working with the problems of demand and supply for technicians provided most of the source material for this dissertation. A specific analysis was made of the utilization of technicians and engineers by almost 100 companies employing some 50,000 engineers in four industries.

The aircraft industry, and the sector of the machine tool industry developing automation equipment were offered as examples of industries where rapid technological changes were creating a demand for new types of workers. The preparation and utilization of technicians in the labor forces of other countries was also considered. The planned programs of England and Russia for the training of technicians were compared with the American methods.

The statistical evidence points to the growth, widespread use, and strategic importance of technicians in the industrial labor force. There appears to be little uniformity, however, in the efforts of employees to extend their short supply of chemists and engineers by using semiprofessional workers for jobs below the professional level.

The growing complexity of modern aircraft and the extensive application of scientific principles to manufacturing methods have created the need for more technical workers in jobs directly related to the production process. The way the aircraft industry met the challenge of training a large number of technicians may be profitably studied by other industries facing similar problems.

The Russians have long recognized the importance of technicians in their labor force. The significance of their training program for semiprofessional workers is that the Soviet labor force may be better prepared for technological changes than the workers of other countries. Furthermore, their workers might provide "built-in" potential sources of industrial progress not found elsewhere.

In a national emergency, dependence upon current American programs for training technicians might prove to be inadequate. Our educational system and the training programs of industry and the Armed Forces ought to be re-examined with this consideration in mind.

186 pages. $2.33. Mic 56-1405

EDUCATION

EDUCATION, GENERAL

A PROGRAM FOR RURAL RECREATION IN TENNESSEE (SECTIONS I AND II)

(Publication No. 12,295)

Catherine Louise Allen, Ed.D.
New York University, 1954

Rural recreation is a much less highly developed field than is urban recreation. New conditions producing changes in farm life present new tasks in planning and organizing recreation for rural people. A major problem is the organization of presently available natural, material and human resources into an effective force for the improvement of the general welfare. Many problems existing in rural areas in Tennessee and in similar agricultural sections make necessary the determination and proposal of the best possible program to meet the needs of the people.

The purpose of this study was to plan a program of community-centered recreation for the rural areas of the State of Tennessee. Seven steps included in problem solution were: determination of fundamental needs and problems of Tennessee people, compilation of recreational process needs, structuring of principles for rural recreation, development of standards applicable to Tennessee, ascertainment of present program status, construction of a core recreation program and composition of a primer of materials and methods of Social Recreation for use by untrained and inexperienced leaders.

Various procedures were used in solution. Fundamental needs were determined by a study of literature which pertained, by interview and by questionnaire. Rural recreation needs of process were compiled from a survey of literature, validated further by submission to a jury; and by interview and questionnaire. A survey of literature was made as foundation for the construction of principles which were then submitted to a jury. Standards applicable to Tennessee were developed from literature and submitted to a jury. The survey questionnaire method was used to obtain information on present status of Tennessee recreation program. Status information in the nine counties of the selected sample was supplemented by the ranking of existing program in the counties by State supervisors conversant with Tennessee, and by interview and correspondence with other qualified personnel. In light of thesis findings and of empirical evidence of four years of intensive rural recreation leadership training, the core program and primer were developed.

The field study of Tennessee disclosed thirteen "people" needs which fell naturally into two categories, i.e., educational needs and human urges, both capable of fulfillment or satisfaction through broad educational channels.

Recreational needs of "process" emerged as: some type of organizational structure; sources of revenue; functional and available indoor and outdoor facilities for use by all of the people; broad all-inclusive programs; group recreation; readily available and usable source materials, methods, equipment and resource persons; trained local leadership; leadership training by State colleges and/or universities; good public relations among all

persons, agencies and organizations; and both general and recreation education for a better way of life.

Among many principles selected as basic were those concerned with the community as the natural center, with democratic organization, with all-inclusive program, with trained local leadership and with recreation education.

Applicable standards centered around organization, program, leadership and facilities.

Results of the study of program status disclosed the parallel of each county's program to its economy; and inadequacy or non-existence in recreational areas of organization, revenue, facilities, trained leadership, broad program and education. However, status analysis disclosed affirmatively the structure and desire for realization of the potential.

Implications for problem solution were: the development of a core recreation program inclusive of all areas of insufficiency, centered around presently available natural, material and human resources, and focused on the achievement of enriched life for rural people; and a manual designed for immediate use in Social Recreation.

Recommendations are for the adoption of the core program and manual in the ninety-five counties of Tennessee and for adaptation, modification and revision based on trial in each individual situation.

534 pages. $6.68. Mic 56-1406

THE CONCEPT OF SUPREMACY OF LAW IN EDUCATING FOR DEMOCRATIC CITIZENSHIP

(Publication No. 16,324)

Charlotte Epstein, Ph.D.
University of Pennsylvania, 1956

Supervisor: Thomas E. McMullin

Statement of the Problem

The problem in this study is to discover how the total concept of supremacy of law is treated in certain widely-used social studies textbooks. However, before this can be undertaken, it is necessary to define the concept for educational purposes, adapting the vocabulary and ideas of those areas of law and behavioral science which deal with supremacy of law. This adaptation, together with a brief history of the concept's development in the United States, serves as a criterion for the analysis of the textbooks.

Method of the Study

The meaning of the total concept of supremacy of law is discussed on the basis of information gathered from the fields of law and the behavioral sciences. Then the history of the development of the concept in the United States is traced, to show how the idea of supremacy of law became a fundamental precept in United States government.

From information received from the publishers of textbooks and from municipal and state educational systems, a list of thirty-six widely-used social studies textbooks is compiled. These books are analyzed in order to discover how they treat the concept of supremacy of law as it has developed in this country and as it has been defined by the other social sciences.

The conclusions emerging from the analysis bear certain implications for the educational profession. These implications are amplified and discussed, and recommendations are made for teaching, for writing textbooks, and for further study in this area.

Results

Generally speaking, those widely-used social studies textbooks analyzed here do not present the doctrine of supremacy of law as a vital facet of American democracy, having its origins in antiquity, its impetus in medieval England, and its flowering in modern democratic governments. The idea is treated piecemeal and incompletely, rather than as a unified concept.

The reading of the textbooks reveals that, throughout, the emphasis is on the supremacy of the people, rather than of the law. Democracy is defined in terms of the people's will, rather than in terms of a stated fundamental law. And, though consideration of minorities is sometimes discussed, majority rule is treated as the most characteristic aspect of democratic government.

The legal system of the United States and its underlying philosophy are not treated with any degree of completeness. Certain laws are discussed, but as a rule, the discussion is limited to the provisions of the laws. Just what law is, is rarely touched upon.

Conclusion

It may be concluded that the total concept of supremacy of law is not given the treatment it deserves in high school social studies textbooks. Taking into consideration the fact that the books have been written for the purpose of presenting subject matter other than that of law, it would seem that the subject of law, which is important in the subject matter of all the behavioral and social sciences, deserves some consistent development in the social studies textbooks. 184 pages. $2.30. Mic 56-1407

A STUDY OF A COMMUNITY TO DETERMINE PATTERNS OF DECISIONS ON SELECTED CONTROVERSIAL ISSUES IN THE PUBLIC SCHOOL

(Publication No. 16,255)

Donald Victor MacDonald, Ph.D.
Cornell University, 1956

Chairman: Lloyd H. Elliott

This is a study of public opinion on selected controversial issues in the public school.

The over-all purpose of this study is to explore some of the ideas and decisions of citizens in a single community about their public school and to test the usefulness of the instrument used in bringing the people closer to the decision-making which affects the operation of the school.

A secondary purpose is to determine the patterns of decisions made by the people about certain controversial school issues and how these compare with the decisions of the Board of Education and staff.

A final purpose is to determine how well the people will respond to an opportunity to participate in the making of decisions affecting their school.

The following controversial issues were studied and they appear on the schedule as propositions:

1. Teachers should be permitted to spank children to maintain discipline.
2. The Regents Examinations should be continued in the school.
3. Elementary classes should not be larger than thirty pupils.
4. Lansing Central School District should build another school building to accommodate its increased enrollment.
5. The school should employ a Reading Specialist.
6. More courses and services should be offered to pupils.
7. Every child should be promoted every year while in the elementary grades.
8. The school should offer a program in Adult Education.
9. Pupils should have more homework.

The data for the study were obtained from a rural-industrial area in Central New York State, and the following null hypotheses tested: there is no significant difference between people with varying characteristics in the decisions they make relative to the nine propositions investigated in this study. These varying characteristics are as follows:

1. Between men and women
2. Between parents and non-parents
3. Between people of various age levels
4. Between people of various incomes
5. Between people of various educational attainments
6. Between people with children in various grades in the school
7. Between teachers and the residents of the district

The chi square statistical technique was used to test these null hypotheses and a level of significance accepted at the five per cent level.

Background factors of age and education seemed to be the only factors which discriminated with any consistency. For the age factor, significant chi squares were obtained for propositions I, II, IV, VIII and IX. For education, significant chi squares were obtained for propositions IV, V, and VIII.

The following general conclusions seemed defensible:

1. Background factors such as sex, parental responsibility, income and grade level of children do not have much effect on the decisions which people make about their public school.
2. Background factors such as age and education have some effect on the decisions which people make about the public school.
3. The instrument used in this study is a useful tool for measuring public opinion on educational matters.
4. The public seems to welcome an opportunity to submit their fundamental beliefs on matters related to the public school.

193 pages. $2.41. Mic 56-1408

REFERRAL PRACTICES FOR THE SELECTION OF CHILDREN WITH RETARDED MENTAL DEVELOPMENT IN THE STATE OF NEW YORK

(Publication No. 14,488)

Gladys Lillian Rhodes, Ph.D.
The Ohio State University, 1955

STATEMENT OF THE PROBLEM

The education law of the state of New York contains a definition of mentally retarded children and a provision for the selection of such children for state-subsidized special classes. The implementation of the law is handicapped, however, by the shortage of state-approved psychological services. The investigator believed that state-approved psychologists were being asked to examine children whom they would not need to examine if such children could be more effectively identified and referred. Moreover, she believed that some children in need of individual psychological examinations were not being identified and referred for such examinations. Because teachers' judgments and the results of group intelligence tests rank high among the criteria used for evaluating children's ability, the investigator chose to examine their use in selecting children with retarded mental development.

DEVELOPMENT OF THE PROBLEM

The research was carried out in Grades III and IV of six public school systems in Livingston County, New York. Seven hundred eighteen children, together with their thirty teachers, shared in the investigation.

Previous to the administration of the California Test of Mental Maturity, each teacher had been asked by his principal to indicate those children in his group who were in need of an individual psychological examination because of retarded mental development. At that time, no teacher knew that he was participating in a study. All children who were referred by their classroom teachers and those children who were found to have an intelligence quotient below 80 on the California Test of Mental Maturity were administered the Revised Stanford-Binet Scale (1937), Form L, by a state-approved psychologist. The children who were found to have an intelligence quotient of 75 or below on the Revised Stanford-Binet Scale were regarded as the control group.

In all, fifty-two children were selected for referral as in need of an individual psychological examination. Forty-three were referred by classroom teachers; twenty-seven were selected for referral on the basis of the results of the California Test of Mental Maturity. Eighteen of the fifty-two children were selected for referral both by the classroom teachers and on the basis of the California Test of Mental Maturity.

Twenty-two of the fifty-two children were found to have intelligence quotients of 75 or below according to results obtained on the Revised Stanford-Binet Scale (1937), Form L.

CONCLUSIONS

On the basis of this study, the following facts were determined:

1. The California Test of Mental Maturity cannot take the place of the Revised Stanford-Binet Scale (1937), Form L, as a basis for placement of children with

retarded mental development in a special class, but it can select effectively a large percentage of children with retarded mental development.

2. The California Test of Mental Maturity selected for referral correctly 74.07 per cent of the time, over-referred 25.93 per cent of the time, and failed to refer 9.09 per cent of the time.

3. Classroom teachers referred correctly 39.53 per cent of the time, over-referred 60.46 per cent of the time, and failed to refer 22.72 per cent of the time.

4. The five school systems in Livingston County not having special classes and not employing a psychologist as a school staff member referred approximately twice as many children as did the one school system having special classes and employing a psychologist as a school staff member.

5. Approximately 42 per cent of the children selected for referrals as in need of an individual psychological examination because of mental retardation were found not to be eligible for special-class placement according to the results obtained on the Revised Stanford-Binet Scale (1937), Form L.

241 pages. $3.01. Mic 56-1409

MECHANIC ARTS PROGRAMS IN LAND-GRANT COLLEGES ESTABLISHED FOR NEGROES: A STUDY OF THE TYPES AND STATUS OF THE PROGRAMS OPERATING AND AN ANALYSIS OF SELECTED FACTORS THAT INFLUENCED THE DEVELOPMENT OF THESE PROGRAMS

(Publication No. 15,964)

Cyrus Byrdart Taylor, Ph.D.
University of Minnesota, 1955

Statement of the problem: The objective of this study was to ascertain the status and types of mechanic arts programs operating in land-grant colleges that had been established for Negroes and to determine which selected factors, if any, had operated to influence the development of these programs.

Method of presenting study: The study presented programs of land-grant colleges as a group and not as a comparison of individual colleges. The study was limited in scope to seventeen land-grant colleges established for Negroes.

Method of collecting data: Data were collected by visitations to border state schools, by the interview and questionnaire techniques, and an analyses of institutional catalogues and selected governmental documents.

Part I set forth assumptions and listed the responsibilities of institutions which were performing land-grant functions particularly as they referred to "mechanic arts." Specific definitions of terminology used in the study were listed. The educational and social-economic forces related to the programs developed were presented to form a background for interpreting present practices.

Part II presented the major findings of the survey.

Major findings:

1. At mid-century the seventeen land-grant colleges had attained a position of leadership in the education of Negroes. The institutions had developed into multi-purpose organizations that reflected efforts of the state to implement the separate-but-equal doctrine, the need for teachers, and the philosophy of top administrators.

2. The functions these institutions were expected to perform often directed their efforts away from their basic land-grant responsibilities. Often these institutions operated without sufficient funds. Facilities were inadequate to meet standards outside the institutions. These were and still remain top administrative problems.

3. A comparison with a 1930 study showed that mechanic arts departments have grown considerably. The types of programs developed were different from those found in typical state-supported engineering and industrial education programs. One reason for this was that curricula in the departments were developed to meet employment practices under the existing occupational color-caste system and dual system of education.

4. Teacher training can be justifiably continued as a function of these departments but a clearer distinction should be made between the preparation of industrial arts and vocational industrial teachers.

5. A considerable part of the work given in mechanic arts was not engineering or teacher training. In the opinion of administrative heads the staffs were satisfactory to do the teaching job required.

6. Many of the technical curricula needed reevaluating. The technical-terminal programs were underdeveloped and the engineering programs showed limited growth and little hope for future development.

7. Major areas of neglect in personnel services were: (a) use of diagnostic data, (b) placement practices, (c) individual counseling, and (d) occupational information.

8. Although general education sequences showed limited development, mechanic arts majors took as many required courses outside the department as other students.

General conclusions: Social-economic and employment trends are improving in the south. This fact along with the influence of the May 1954 Supreme Court decision, suggests a re-direction of the program of land-grant colleges once established for Negroes. The educational programs of each state, favorable community attitudes, the adequacy of facilities in mechanic arts departments, and the location of schools should be major factors to be considered in the new-orientation. Mechanic arts departments must now evolve programs to meet manpower needs differing from the pattern imposed by the occupational color-caste system. Departments that fail to meet this challenge may encounter more and more difficulty in obtaining public support.

477 pages. $5.96. Mic 56-1410

EDUCATION, ADMINISTRATION

A PROPOSED PROGRAM OF POLICIES, REGULATIONS, AND CRITERIA FOR THE APPROVAL OF IOWA PUBLIC SECONDARY SCHOOLS

(Publication No. 16,109)

Wesley Adam Erbe, Ph.D.
State University of Iowa, 1956

Chairman: Associate Professor John E. McAdam

Purpose

The purpose of this study was two-fold, namely (1) to ascertain the policies, regulations and criteria applied by agencies that accredit secondary schools in the United States and the procedures followed by these agencies; and (2) to formulate a set of standards based on the discovery of most common practices which might be utilized by the State Department of Public Instruction in the approval of public secondary schools in this state.

Procedure

Departments of Public Instruction of forty states, universities of two, and accrediting commissions of six were contacted for statistical information on the approval of public secondary schools in their respective states. The four regional associations supplied data on accreditation by their agencies. Conferences were held with staff members of the State Department of Public Instruction in Iowa.

Conclusions

Secondary school approval originated as a means of admitting high school graduates to college. Since 1871 there has been continuous secondary school approval by an agency of the state, by the university, or by a non-legal commission.

It was found that four states, including Iowa, currently have no published statements of standards for secondary school approval. Common standards used by both state and regional agencies were found to include the following items:

1. Purpose of secondary school approval. 2. General administrative standards. 3. Standards for all staff members. 4. Desirable building and site. 5. Educational program. 6. School library. 7. Length of school year, school day, and class period. 8. Teacher load and assignment. 9. Special services. 10. Records of pupils and teachers. 11. School morale and staff stability.

Both regional associations and states which accredit or approve secondary schools have established standards for administrative and other professional personnel, these standards varying from the master's degree, which is a common requirement for administrators, to the bachelor's degree for all other professional personnel.

Thirty-nine states have established minimum standards for school plants, sites, equipment, and supplies. The common practice is to specify that they be adequate to provide for the educational needs of the students.

Twenty-seven states have standards relating to the educational program with specific emphasis on the curriculum of the school. Regional associations make special reference to the educational program in terms of the curriculum and courses of study, pupil activities, the library, guidance, and instruction as they relate to educational outcomes.

A standard pertaining to school morale is contained in the handbooks of twenty-four state accrediting agencies, and staff stability is a standard of accreditation in fifteen states.

The general educational conditions of Iowa secondary schools revealed the type of approval program usable in this state. Problems of school size, pupil-teacher ratio, number of teaching positions per school, and the assessed valuation per child were considered as factors relating to secondary school approval in Iowa.

Because regional agencies are selective, there is no state in which all public high schools hold membership. State accreditation encompasses every high school. Therefore, established state standards should be available to all schools.

Accreditation and approval programs of both state and regional agencies are designed to assist schools in meeting the needs of all pupils. Approval standards provide state agencies with instruments for determining the effectiveness of school programs. Items of a qualitative nature allow freedom to develop programs best suited to the needs in their respective school communities.

As a result of analyzing the policies, criteria, and regulations of the regional accrediting associations and the approval and accreditation programs of the forty-four states that have developed and published standards to guide them in conducting such programs, a recommended plan for the approval of the public secondary schools in Iowa was presented. 159 pages. $1.99. Mic 56-1411

REFINEMENT OF AN INSTRUMENT TO DETERMINE CERTAIN CHARACTERISTICS OF THE WORKING PATTERNS OF SCHOOL PRINCIPALS

(Publication No. 16,357)

Doc Farrar, Ed.D.
The University of Florida, 1956

This study, a part of the University of Florida Leadership Project, has five purposes: reclassifying the responses in the key situations of the Principal Behavior Check List to form a continuum; assigning values to the responses in accordance with these classifications; scoring principals on this scale and determining the internal consistency of the items; eliminating items not differentiating between high and low scoring principals; and determining the validity of the altered instrument by using parent-school relations as the criterion.

The Principal Behavior Check List, developed by Alpren, contains 86 problems often encountered by school principals, with possible responses for each. Using this instrument, a principal and five teachers can describe the principal's most frequent behavior. It was administered by Van Aken in 75 schools. In another study, Henderson administered a Parent Questionnaire on School Relations in 48 schools studied by Van Aken.

Present Study

In this study, a 5 point continuum was developed, ranging from democratic to undemocratic. Six independent judges classified the alternatives in 55 key situations on this new continuum. The principal behavior recorded by Van Aken was scored on this new scale, and each principal given a mean score.

Two methods were used to develop short forms of the instrument. The twenty key situations that showed the highest correlation with principal scores on the entire scale were included in the T R Form. The G D Form was composed of the twenty key situations that reflected the greatest differences between the means of the upper and lower 27 per cent of the principals.

The F-K AU and F-K D Scales, developed by Van Aken, show the frequency with which the principal uses democratic and authoritarian behavior in the 55 key situations. Henderson found that an increasing frequency of democratic behavior by the principal was accompanied by more favorable parent-school relations.

The G D Form showed a higher correlation with the F-K AU Scale and the F-K D Scale than did the other forms of the democratic-undemocratic scale. Correlations indicate that the G D Form is more accurate in predicting relations within the schools than are the other instruments developed in the Florida Leadership Project. Much greater differences were found in parent-school relations between extreme groups of schools selected by the G D Form than Henderson found between extreme groups selected by the F-K AU and F-K D Scales.

When principal job behavior on the G D Form was compared to personality characteristics as measured by the F Scale and the Guilford-Martin Inventory of Factors GAMIN, the results were similar to Van Aken's. No relationship was found.

As measured by the G D Form, women principals are significantly more democratic than men. When principals were separated on the basis of sex, correlations between principal scores on the G D Form and parent-school relations were not significant.

Other studies are needed to: (1) improve the accuracy of scoring the instrument (2) to determine if the instrument differentiates enough between principals of the same sex to permit valid predictions of relation within the school (3) to improve the discrimination of item responses of the instrument. 183 pages. $2.29. Mic 56-1412

THE ELEMENTARY SCHOOL PRINCIPAL IN NEBRASKA

(Publication No. 16,241)

Myron Lloyd Holm, Ph.D.
The University of Nebraska, 1956

Adviser: Merle A. Stoneman

The elementary school principal was Nebraska's first school administrator. The principalship was from the beginning a recognized leadership position based on clearly defined duties and responsibilities and the authority to implement these into action. The present study sought to develop from educational history a brief story of the early schoolmasters in America in the more than two hundred years prior to the state's beginning. This colonial and subsequent background obviously influenced the status and role of the first Nebraska principal. The principalship in the past one hundred years has developed in many of its aspects. As a consequence of great population increase in the United States, the advance of urbanization and the corollary populous school district, and the expansion and extension of school services, the elementary school principalship has become established. Nebraska has been part of this nationwide development and the evolution of the principalship.

The content of the questionnaire-checklist used in the study grew out of the large body of historical information concerning the duties and responsibilities charged to elementary school principals. This was supplemented by such duties and responsibilities as were suggested and recommended by authorities in the field of elementary education. Cognizance was also given to handbooks and pamphlet material published by state departments of education and other agencies, as well as previous studies in the field.

A significant phase of the study was out-of-state personal visitations with fifty-six outstanding elementary school principals. These principals were recommended for visitation by personnel in state departments of education and city school superintendents as being successful principals in positions of high responsibility, exhibiting evidences of personal competence and excellence of professional leadership. Their replies to the same questionnaire-checklist as used by Nebraska principals gave a basis for comparison.

From the replies to the questionnaire-checklist are derived the following summarizing statements: (1) many individuals in Nebraska carrying the title of elementary school principal have neither training nor experience as recommended by authorities for those in such positions; (2) many elementary school principals in Nebraska are delegated neither the responsibility nor the authority to perform the duties as indicated by authorities; (3) the position of elementary school principal does not exist in many school situations in Nebraska where according to authorities such a position should be established; and, (4) training programs for the elementary school principalship in Nebraska should be further developed in order to provide adequate training for practicing and prospective elementary school principals.

Four conclusions selected from those which developed from the study are listed below.

1. The elementary school principalship should draw the finest, most capable teacher trainees.
2. The elementary school principalship training sequence of courses should develop the prospective candidate to a point of readiness at an earlier age.
3. Elementary principals are thinking of their principalship role as one of democratic leadership.
4. Elementary principals are diverted from fullest supervisory and child adjustment activities, and other service roles by routine clerical duties and administrative details.

Four recommendations drawn from those which were made as a result of the study are listed below.

1. The Nebraska State Elementary Principals Association should continue and broaden their professional study projects.
2. The Nebraska State Education Association and other educational leadership should study the matter of state certification for those persons occupying the elementary school principalship.
3. Individual school system should provide supervising principals for individual elementary school units of 250-300 pupil population or more.
4. Professional training programs should be designed to the extent feasible to apply directly to elementary school administration, supervision, and other areas.

304 pages. $3.80. Mic 56-1413

AN INQUIRY INTO THE RELATIONSHIP BETWEEN EARLY SCHOOL LEAVING AND ATTITUDE TOWARD AUTHORITY FIGURES

(Publication No. 15,397)

Kingsley Montgomery, Ed.D.
Michigan State University, 1955

THE PROBLEM. This study was an inquiry into the relationship between early school leaving and attitude toward authority figures. The purpose was twofold: (1) to determine if those who left school prior to completion of the 12th grade expressed more hostility towards teachers, police and parents than did a matched group who remained in school, (2) to determine if there is a relationship between hostility and job turnover and hostility and delinquent behavior.

METHODS, TECHNIQUES, AND DATA. The investigation was conducted using a sample of eighty-six subjects. Half of this sample were youths who had voluntarily dropped out of the Detroit public school system sometime after their 16th birthday but prior to graduation. These subjects were a selected sample from the total number of students leaving school in the Fall term, 1953. The control group was composed of youths who were attending school at the time of the study. Subjects in this group were chosen individually to match the school leavers in these variables: age within six months, race, sex, intelligence within the same letter grouping, high school and socio-economic level as determined by the father's occupation.

Each member of the sample was interviewed. A semi-structured questionnaire was employed and responses to various questions were recorded by the investigator. The questions were designed to elicit attitudes toward such authority figures as teachers, police and parents and to obtain such other information as was pertinent to the inquiry. Also at the time of the interview the 'F' Scale, authored by Adorno, Sanford, et al., was administered to each subject. This scale was selected as a more subtle approach to the measurement of hostility than were direct questions. The instrument was also used as a means of checking the reliability of any judgments as to whether or not the subjects in the sample were or were not hostile toward those in authority. The records of the Youth Bureau of the Detroit Police Department were consulted to determine which persons in the sample had been apprehended for delinquent acts.

From the responses obtained on the questionnaire, two judges categorized the subjects as: (1) expressing hostility toward authority, (2) expressing no hostility, or (3) expressing ambivalences. Statistical techniques were used to determine: (1) percent of agreement between the judges and significance of the judges' ratings, (2) statistical significance of the difference between the experimental and the control group on the 'F' Scale, (3) relationship between degree of judged hostility and job turn-over, (4) relationship between those of the drop-out group who were in the top and bottom 27 percent on the authoritarian measure and job turn-over, and (5) relationship between delinquency and score on the 'F' Scale.

FINDINGS AND CONCLUSIONS. The judges found that more of the experimental group expressed hostility toward those in authority than did those in the control group. They were in agreement 68 percent of the time. The findings of each judge were submitted to a chi square test and each showed a significance at the 1 percent level of confidence. The 'F' Scale could discriminate between the drop-out and the non-drop-out at the 3 percent level of confidence. Those of the experimental group judged hostile did not have a significantly higher job turn-over rate than those judged to be not-hostile. Those of the experimental group who were in the top 27 percent in scores on the 'F' Scale had no significantly greater job turn-over rate than those scoring in the bottom 27 percent. No significant correlations could be found between delinquency and score on the authoritarian measure.

The hostility held by the subjects in the experimental group did not carry over to the job situation to the extent that they obtained and left jobs more frequently than those who were not-hostile. Too, those who were in trouble with the police were not uniformly hostile as measured by the authoritarian scale. The judges decided that the early school leaver expressed more hostility than did the school non-leaver. The findings using the 'F' Scale supported the judges' findings in that the drop-out was more of an authoritarian personality than the non-drop-out, thus had underlying feelings of hostility.

128 pages. $1.60. Mic 56-1414

AN ANALYSIS OF THE PROCEDURES OF THE FIRST TEMPORARY REGIONAL SCHOOL PLANNING COMMITTEE IN CONNECTICUT WITH RECOMMENDATIONS

(Publication No. 13,655)

Bernhard Wesley Schneider, Ed.D.
New York University, 1955

The Problem and its Importance

High schools in Connecticut which have been receiving students from surrounding rural towns for many years are finding they can no longer accommodate out-of-town pupils because of increased enrollments. Many of these rural towns are now faced with the problem of providing their own facilities for secondary youth for the first time. It was

the intent of the Connecticut Regional School District Act of 1951 to facilitate the efforts of these towns to examine regional planning as a possible answer to their problem through the formation of a temporary Regional School Planning Committee.

The purpose of this investigation will be to analyze the procedures of the first committee established under the Connecticut Regional School District Act of 1951, with special reference to the three requirements outlined in the statutes for the Committee, namely; to determine the advisability of establishing a regional school district, to estimate the cost of providing necessary land and school building facilities and to make recommendations to their respective towns. Recommendations based on the analysis of these aspects are proposed to assist other regional school planning committees in Connecticut.

Procedure in Collection and Treatment of Data

Data were obtained from the files of the Winsted Rural office of the Connecticut State Department of Education which contained the records, tabulation, deliberations and recommendations of the Joint Boards of Education, the Temporary Regional School Planning Committee, and their sub-committees. The historical method of research was used in the collection, the criticism and the presentation of data. The normative-survey method was used to determine the type of curriculum each town felt should be considered in the proposed high school and also to determine the reactions of the Planning Committee to questions evaluating the effectiveness of their practices and procedures.

The procedures, utilized by the Planning Committee to meet the requirements identified above, were examined with regard to how the committee defined the problem, worked on the problem, reached conclusions as well as how the committee made use of participation in the working procedures. It is within the latter area that the study reveals a basic recommendation for other planning committees.

Recommendations or Guideposts for Future Planning Committees

Although the Regional School District Act charges the planning committee with the responsibility of making recommendations to the towns, this study indicates that if the elected members of the planning committee would act as a steering committee responsible for the overall study, numerous other influential citizens could be involved in the detailed fact-finding, which would assure a broader base of community understanding to act on the recommendations of the planning committee.

Those who recommend a planning committee should keep the community informed of the need and the job of such a committee and encourage the selection of its members to be based on broad qualifications. Although the practices and procedures developed in this study are recommended to future committees, the study reveals the need for several guideposts for those participating on the committee.

1. The committee should give as much attention to the consensus of the opinion of the members to take each step as to consideration of the value of the step to be taken.
2. The committee should periodically review the necessity of involving other citizens in the fact-finding.
3. All the evidence necessary to solve a problem should be investigated and presented.
4. The recommendations of the committee should be supported by this evidence.
5. The planning committee should give as much attention to the quality of the information gathered as to the effectiveness with which the information is distributed.

164 pages. $2.05. Mic 56-1415

AN ANALYSIS OF THE ADMINISTRATION OF EDUCATIONAL TELEVISION IN INSTITUTIONS OF HIGHER EDUCATION

(Publication No. 15,395)

James B. Tintera, Ed.D.
Michigan State University, 1955

The purpose of this dissertation is to: (1) study the organization of educational television in institutions of higher education; (2) relate the administrative pattern to the effective utilization of television by the institutions; (3) identify, analyze, and evaluate factors of administrative operation of educational television activities; and (4) determine factors which encourage or retard the development of educational television in colleges and universities.

To accomplish these purposes a quantitative and evaluative study of the administration of television activities was conducted with 186 institutions of higher education having television facilities and with the eight institutions operating television stations. Data was collected by means of a survey questionnaire, a structured interview with the station managers, direct observation, and an interview with the next highest administrative authority above the station managers.

The development of educational television is a slow process with institutions conducting this development in five consecutive stages, any one of which may be a termination stage. These are: (1) beginning interest in programming via local stations; (2) the purchase of film equipment to enlarge programming; (3) the installation and operation of a television studio for rehearsal and experimentation; (4) a link of the studio with a local transmitter to broadcast on-campus programs; and (5) the operation of a television station.

Most institutions (97) are found in stages 2 and 3 with only a few (8) in stage 5. At the present time there is no clearly identified movement on the part of institutions of higher education to establish educational television stations.

The major recommendations of this study are: (1) closer involvement of the community in the television programming by colleges and universities; (2) administrative placement of the television activity directly under the Office of the President of the institution; (3) the identification of the television program staff with the academic areas of the institution; (4) the utilization of students as television production and program personnel for purposes of economy, broadening the experiences of the students, and expanding the scope of the creative effort applied to the productions; (5) the creation of academic departments or divisions devoted to the preparation of personnel on a graduate level to assume positions of responsibility in educational television; (6) colleges and universities should assume greater responsibility in the continued

experimentation and investigation into the utilization of television in education; and (7) continued research into the improvement of the general standards of the television industry, the effectiveness of television as a mass media of communication to interpret the university to the public, and the use of television equipment as an audio-visual aid in education. 248 pages. $3.10. Mic 56-1416

THE DEVELOPMENT OF A METHOD FOR CODIFYING SCHOOL BOARD POLICIES

(Publication No. 15,281)

Roy Carroll Turnbaugh, Ed.D.
University of Illinois, 1955

The purpose of this study was to develop and try out a procedure for use in codifying the policies of a board of education in a local school district. The study sought to explore the ways in which policy statements may operate to improve education in a school district and to relate a codification procedure to the educational goals written policies might help to accomplish. It was assumed that the procedure used in developing policies is closely related to the understanding and acceptance of them by the individuals and groups concerned with them.

The extensive literature on the subject of school board policies provided much helpful information on the purposes of written policies and the characteristics of good school district policy manuals. The literature gave some help in laying out the major requirements of a successful method for codification.

A try-out procedure for experimental use in Barrington Consolidated High School at Barrington, Illinois, was based on the recommendations found in the literature and on experience in the school district. Leadership and coordination for policy codification were supplied by the high school principal. He consulted the minutes of school board meetings, administrative bulletins, faculty workshop reports, and other documentary sources. Work toward preparing written policies was done with the superintendent and his staff, the school board, the faculty, and other employees. A questionnaire on policies, prepared with faculty help, was administered to the school board and school personnel. Widespread participation in each step of the codification effort was a major goal of the procedure used.

Observational records were maintained throughout the codification of policies. The use of time at board meetings was analyzed. A record of the frequency of spoken participation in board meetings was maintained for the period of the study. Also recorded were actions of board members which fell in six behavior categories as developed by Barnhart in a study of school board members. School board minutes were carefully examined. Records were maintained on the participation of the superintendent, the principal, the assistant superintendent, the executive secretary, the attorney, the teaching employees, and the non-teaching employees.

Conclusions of the study were (1) the procedure was found to be usable in codifying policies in a local school system; (2) policy codification does not require a prohibitive amount of time; (3) spoken participation in board meetings tended to become more evenly distributed among board members while policies were being codified; (4) spoken participation in board meetings tended to become more evenly distributed among all those regularly attending while policies were being codified; (5) spoken participation of school administrators tended to be relatively more frequent at board meetings when policy items were under consideration; (6) the number of entries in the minutes expressing clear policy intent showed a slight increase while policies were being codified; (8) board members were frequently observed to apply helpful personal knowledge and experience to school problems both before and during codification; (9) individuals tended to favor statements assuring their freedom of action or prerogatives and to resist statements establishing limits for them; (10) prior to codification policy statements in the minutes were preceded by conflict; (11) individuals newer in their positions tended to invest more effort in policy codification than others; (12) those who worked most on the manual tended to persist in similar work to establish and clarify functions and relationships within their spheres of activity.

The study recommended further research to determine whether the procedures used in Barrington can be successful elsewhere and to explore systematically the effect on school boards and school personnel of working under written policies. The use of school boards in studying the behavior of groups in problem-solving activities was also recommended. 222 pages. $2.78. Mic 56-1417

EDUCATION, ADULT

THE GROUP DISCUSSION-DECISION APPROACH—AN APPRAISAL OF ITS USE IN HEALTH EDUCATION

(Publication No. 15,918)

Betty Wells Bond, Ph.D.
University of Minnesota, 1955

Previous studies by Lewin and his associates indicated that group discussion, with ensuing group decision, was more effective than other methods of instruction in influencing behavior.

The present study compared the effectiveness of two methods, (1) lecture and (2) group discussion-decision, in a health education program concerned with chronic illness. The problem chosen was breast cancer in women, mainly because criteria of success in that field were fairly amenable to objective measurement.

One main hypothesis was considered. Stated in the usual null hypothesis form, it is that group discussion-decision methods do not result in a significantly higher level of motivation toward the advocated health practices than would be attained by providing the same information through lectures. Motivation, as demonstrated by the establishment of these health practices, is thus taken as the measure of the value of these procedures, rather than increased knowledge of the disease and its control.

The three criteria of success adopted were (1) the obtaining of a breast examination from the woman's physician to determine the normality of her breast tissue, (2) the

practice of monthly breast self-examinations and (3) demonstration to the physician or his assistant of her technique of breast self-examination.

The cooperating physicians and their office staffs were oriented to the program and prepared for the visits of women who might seek these services. Meetings were conducted by one person, the present investigator, in 42 discussion-decision and 33 lecture groups in Duluth, Minnesota, with only one type being held in any one study area. The groups selected were small pre-existing groups, not organized around any health subject, with a typical size of 10 to 14 women. At the original meetings, 933 women were present.

Two interview follow-ups were made, a preliminary one within seven months and the final follow-up thirteen months after the meetings. A slight loss of cases occurred, with a decline to 899 at the time of the first follow-up, and to 871 at the 13-month follow-up.

Comparison of the two groups (discussion-decision and lecture) as to personal characteristics showed them to be homogeneous with respect to the marital status, attachment to persons with cancer, group memberships, and leadership positions held in various organizations. However, the discussion-decision group contained a higher percentage of young women (under 40 years of age). There was also some doubt as to the comparability of their formal schooling. Various measures of group cohesiveness failed to show any significant differences between the two groups.

The major hypothesis of this study was rejected, since there were statistically significant differences favoring the discussion-decision group (at the .01 level) on all three stated criteria of success, both at the preliminary and the thirteen-month follow-ups.

The data were also studied to determine possible relationships among other variables and the performance of these women on the criterion measures. None of these variables sustained a consistent relationship for both the discussion-decision and lecture groups on the various recommended practices. The occasional differences found were usually limited to the lecture group, and in no instance compared in size with those associated with the instructional methods used.

The differences between the discussion-decision and lecture groups were even more marked at thirteen than at seven months; on the criterion (breast self-examination) which demanded continuing effort, the performance of the women in the discussion-decision group had increased while that of the lecture group had decreased.

The evidences thus pointed quite consistently to the superiority of the discussion-decision approach in motivating women toward advocated health practices.

304 pages. $3.80. Mic 56-1418

ORGANIZATION AND ADMINISTRATION OF ADULT EDUCATION PROGRAMS IN SMALL POPULATION CENTERS

(Publication No. 16,237)

John Elmer Dalton, Ph.D.
The University of Nebraska, 1956

Adviser: Knute C. Broady

The purpose of this research is to formulate criteria which may serve as guiding principles in developing an adult education program and to describe aspects of successful programs which may serve to illustrate sound procedures for the formulation of adult education programs sponsored by the public schools.

Procedures which were followed in this study included: (1) review of the literature, (2) formulation of a statement of principles which was submitted to fifteen experts in the field of adult education, (3) personal interviews with program directors and observation of programs in operation, (4) development of a questionnaire, and (5) compilation and analysis of data received from personal interviews and questionnaires.

One hundred public school adult education programs were studied. Data were gathered from thirty-two programs by personal interviews. Sixty-eight programs were surveyed by questionnaires. The writer corresponded with leaders in state departments of public instruction, state universities, and in state colleges in locating successful adult education programs which they felt would contribute to this research.

Administrators of successful adult education programs which are organized and administered by the public school must give serious consideration to the following:

(1) The board of education must be willing to endorse a program of general adult education. If their support is to be meaningful, it is necessary that board members become acquainted with the philosophy and underlying principles of adult education.

(2) The administrative officers of the school must accept adult education as a significant area of the total educational program, if adult education is to succeed.

(3) Responsive leadership, both professional and lay, is essential to a successful adult educational program. Ninety-four percent of the directors of the adult programs included in this study held other positions directly connected to the school, and eighty-five percent of those reporting indicated that lay leadership was used in the management of the individual courses.

(4) Approximately two-thirds of the programs surveyed utilized a lay committee in planning, promotion and appraisal of adult education programs. Even those directors who do not work with advisory committees heartily endorse the utilization of the citizens of the community in developing an adult program.

(5) Determining the needs and interests of the adult population is imperative if an adult education program is to be continuous and worthwhile. In fact, directors believe that determination of needs is one of the most challenging problems facing adult educators today.

(6) Nearly eighty percent of the schools charge tuition, usually $5.00 or less. Where no charge is made state aid for adult education is generally available.

Instructors receive up to seven dollars per class-contact hour, but in three communities no remuneration is given. Twenty-two percent of the communities pay $2.50 per hour, while nineteen percent pay $3.00 per hour.

(7) The program should be democratically planned. Flexibility within a course and a willingness to adapt courses to expressed desires are essential characteristics of all adult education programs.

(8) Evaluation is an integral and a requisite factor in every adult program. To obtain the greatest value from an adult program, this evaluation should be continuous as well as pertinent and involve administrators, group leaders and enrollees.

Adult education is not only an opportunity but it is becoming increasingly apparent that it is an obligation because it provides the means whereby all adults can attain a sense of belonging, a feeling of worthiness, tangible evidence of achievement, and an insight into responsibility.

235 pages. $2.94. Mic 56-1419

EDUCATION, HISTORY

EDWARD CHARLES ELLIOTT, EDUCATOR (PARTS I-III)

(Publication No. 16,453)

Frank Kleiser Burrin, Ph.D.
Purdue University, 1956

Major Professors: Paul Alexander and M. B. Ogle

The study represents an effort to organize and present in ordered form for future reference an analysis of selected papers and works of Edward Charles Elliott, President-Emeritus of Purdue University.

It was proposed in this study:

1. To present significant excerpts from the published and unpublished papers prepared by Elliott during his career in education.
2. To organize these selected papers so that his educational views may be made readily available for study by those who are working toward the solution of the educational problems of today.
3. To relate his educational views to the general development of education in America during the period 1900-1950.

The work required a study of all available materials prepared by Elliott over the last fifty-eight years. This study and review encompassed more than one thousand separate items -- addresses, articles, books, book reviews, introductions, letters, and reports.

The problem was to select significant portions from his various publications and organize these excerpts so that the highpoints of a distinguished career would appear in their logical sequence.

The primary source of materials was Elliott's collection of his papers and addresses. The collection, which dates from 1891, includes manuscripts, typed and mimeographed materials, printed papers taken from the original publications, books, reports, letters, and press clippings. Perhaps of greatest value to the writer was the opportunity for extended conversations with Elliott.

The text was divided into three parts. Part I, which includes Chapters I and II, provides a statement of the problem; outlines the nature and purpose of the study; reports the method of procedure, sources of data, and plan of organization; and presents a brief biographical sketch of Elliott.

Part II (Chapters III through VI) contains the detailed review of the Elliott papers. Chapter III reviews the years 1897-1903 (Leadville, Colorado); Chapter IV, 1905-1916 (University of Wisconsin); Chapter V, 1916-1922 (University of Montana); and Chapter VI, 1922-1945 (Purdue University).

Part III (Chapters VII and VIII) provides a summary of the entire study together with recommendations for further study and conclusions.

The concluding chapters point out Elliott's pioneering work in the areas of teacher training, school surveys, measuring teacher competency, and the marking of school work. As a university administrator, Elliott contributed greatly to the success of the chancellorship plan in Montana, and provided strong leadership during his twenty-three years at Purdue University.

296 pages. $3.70. Mic 56-1420

AN HISTORICAL ANALYSIS OF THE DEVELOPMENT OF HIGHER EDUCATION IN NIGERIA (PARTS I AND II)

(Publication No. 13,604)

Alliu Babatunde Fafunwa, Ph.D.
New York University, 1955

The problem of this study is to trace, analyze, and evaluate the development of higher education in Nigeria from 1928 to 1953 with a view to ascertaining the extent to which higher education is meeting the social, economic and political needs of the Nigerian society.

Nigeria, as a British Colony, is rapidly approaching responsible self-government. Most of the Nigerian political leaders have set the year 1956 as their goal for independence, while the British Government has agreed to consider this question with the Nigerian leaders at a constitutional conference to be held in 1956. As in all other underdeveloped countries of the world, higher education will play a very significant role in the national life of Nigeria.

It is discovered that the higher educational development in Nigeria is a series of improvisations in that it consistently lacks over-all long-range planning. The British educational system dominates Nigerian education at all levels, while the sole objective of higher education is to meet the British standard at the expense of Nigerian needs. The only four-year institution in Nigeria, Ibadan University College, is a tutorial, residential, highly academic institution which prepares its students for the London University's baccalaureate degree in liberal arts, science, agriculture and pre-clinical medicine. This college, with a $10 million physical plant, $11 million endowment fund, 400 students and 103 teachers, is one of the most luxurious

institutions of its kind anywhere. The college is designed to train a microscopic minority in a country where 80% of its people cannot read or write; and in a territory where adequately trained personnel are urgently needed in the areas of public health, education, agriculture, research, town and rural planning and housing, transport and industry.

The new Nigerian College of Arts, Science and Technology is planned to complement Ibadan University College. Its planners are torn between making it a superior high school and a two-year college.

Two thousand four hundred Nigerians are currently enrolled in British and American universities as compared with the 400 students now enrolled at Ibadan University College in Nigeria; the average cost for training a Nigerian abroad per year is $1,800 in the United States and $1,100 in Britain, while it costs the Nigerian Government an average of $2,000 a year to maintain each of the 400 students at Ibadan University College.

Nigeria as a young and developing country cannot afford to train an elite if it intends to remain free, strong and democratic after its independence. The educational system that is divorced from the country's economy and designed primarily for the training of a privileged minority in a country where mass illiteracy is the order of the day needs drastic revision. It is therefore recommended that Ibadan University College be liberalized and its curriculum expanded to include departments of teacher training, economics and statistics, engineering, veterinary medicine, home economics, business administration, sociology and public administration. The present facilities at Ibadan are adequate to accommodate 1,000 students almost immediately; this is possible without increasing the annual recurrent expenditure and without increasing the faculty except when the proposed new courses are added. The new Nigerian College of Arts, Science and Technology, (which, according to the Nigerian Government estimate, will cost $5,600,000 to build and will accommodate 1,000 students) should be converted into an agricultural and mechanical college to accommodate 2,000 students. By 1958 Ibadan College should enroll 2,000 students; and the Nigerian College, 5,000.

Free and compulsory universal education should be introduced in Nigeria within the next five years. Meanwhile, the present teacher training schools should be expanded and their standards raised to train more teachers of better calibre. 379 pages. $4.74. Mic 56-1421

A HISTORY OF PENNSYLVANIA MILITARY COLLEGE—1821-1954

(Publication No. 15,572)

Clarence Russel Moll, Ph.D.
New York University, 1955

The Pennsylvania Military College stems from John Bullock's Boarding School for Boys founded in Wilmington, Delaware, about 1821. It also traces its origin to the Wilmington Literary Institute, incorporated in 1843 by Corry Chambers, which later introduced military training under Captain Alden Partridge and in 1847 was chartered as a collegiate military institute.

Theodore Hyatt, who had purchased the Bullock School, introduced military training in 1858, and a year later it was incorporated under the charter of the Wilmington Literary Institute as the Delaware Military Academy.

Influenced by a need for larger quarters and a conflict between Theodore Hyatt and Governor Burton over the use of state arms, Hyatt moved to Pennsylvania where he obtained a university charter for his Academy from the Pennsylvania legislature on April 6, 1862.

In 1867, a group of Chester citizens incorporated for the purpose of erecting buildings for the Academy, establishing the institution in its present location in 1868. This property eventually fell to the Hyatt family who operated the school as a business venture.

The organization of the Pennsylvania Military Academy was patterned after West Point, based on the premise that the military system was efficient and effective for integrating the scholastic, military, spiritual, and physical life of the student.

Educational offerings in the Pennsylvania Military Academy at its inception included both engineering and liberal arts programs, but the latter, which had virtually no enrollment, were subsequently displaced by an increase in engineering and scientific curriculums. The first degree was given in 1867, and degrees have since been granted without interruption.

Pennsylvania Military Academy was in 1869 the first military college in the United States to be assigned a United States Army detail and three years later to receive federal arms. Its name appeared on the first list of distinguished institutions published by the War Department in 1904. It was among the first non-land grant colleges to receive an R. O. T. C. unit. Its graduates have served with distinction as officers in every United States war since 1860.

To give it collegiate characteristics in name as well as charter, the corporate name was changed to Pennsylvania Military College in 1892. The institution lost many of its collegiate characteristics in the early part of the 20th century. By the end of the First World War, although still granting degrees, its four-year program was no more than two years of high school and two years of college.

An engineering and scientific school until 1916, the College then broadened its offerings to include business administration. The College first adopted a conventional four-year curriculum requiring 15 units for admission in 1922.

During the nineteen-twenties, the College sought renown through broad programs of intercollegiate athletics. Its nationally known polo teams played in Madison Square Garden. Honorary degrees were given to numerous celebrities at Commencement Exercises amid much publicity and fanfare.

In debt, the private corporations operating the College went bankrupt in 1935. In 1936, private interests of the Hyatt family were transferred to the Board of Trustees of Pennsylvania Military College. Henceforth, the Board controlled the business as well as the educational management of the institution and the College was declared tax-exempt by the U. S. Treasury Department.

A large veteran enrollment after World War II gave Pennsylvania Military College opportunity to establish itself as a sound collegiate institution. Engineering, business, and scientific offerings were expanded and liberal arts was reintroduced. Standards of admission were raised, facilities increased, and a system of faculty

government was established. These paved the way for accreditation by the Middle States Association of Colleges and Secondary Schools in 1954.

481 pages. $6.02. Mic 56-1422

EDUCATION, PHYSICAL

ORIGINS OF SOME MODERN SPORTS

(Publication No. 16,392)

Marvin Howard Eyler, Ph.D.
University of Illinois, 1956

PURPOSE: The central purpose of this study was to determine the origin of as many sports as possible extant in English-speaking countries. More specifically, the study attempted to: (1) fix a date of origin for each sport, or, in the event this was impossible, to cite the earliest reference to the sport in the literature, (2) establish the place of origin, (3) name the person or persons connected with the origin and (4) present the circumstances accompanying the genesis of the sport.

METHOD: This study involved principally the use of the historical-bibliographical method of research and was concerned with the collection and criticism of source material in an effort to ascertain factual data. The study represents the most accurate statement possible concerning the origins taken from sources available in the New York Public Library, the Library of Congress and the University of Illinois Library.

FINDINGS: Specific documentary evidence concerning the date, place, personnel and significant circumstances associated with the origins of ninety-five sports extant in English-speaking countries were synthesized. In most instances, fixing the date and place of origin was possible. In many instances, determining the personnel and the circumstances connected with the origins was not possible. Charts in the concluding chapter (III) showed the dates of origins chronologically, the origins attributed to various countries, and the activities from which the ninety-five sports evolved.

CONCLUSIONS: (1) Thirty extant sports originated before 1800; forty-nine sports originated during the nineteenth century, and sixteen originated after 1900. The substantial increase during the nineteenth century paralleled the Industrial Revolution and the concomitant increase of leisure time. (2) England and the United States were the sites of origin for fifty-six or 59% of the sports covered. This may or may not be significant since one of the limitations was to include only those sports practiced in English-speaking countries. (3) The higher percentage of sports attributed to England and the United States may be due to the greater amount of leisure time available to the inhabitants of these countries. (4) Of those sports originating in the United States (24), seventeen or 71% started after 1890. Compared to older European cultures, this finding implies a rather late sports awakening. This may be due, in part, to the relatively late development of this country and again, the correspondingly late Industrial Revolution in this country. (5) In general, of the ninety-five sports covered, three emanated from children's play activities (miniature auto racing and soap-box racing), nineteen were invented (basketball and volleyball), four came out of a search for food or livelihood (hunting and fishing), twenty-six evolved from what might be termed natural activities such as transportation and communication (skiing and pedestrianism), eight were originally affiliated with religious or ceremonial activities (tennis and lacrosse), two emerged from scientific exploration (mountaineering and soaring), thirteen resulted from activities primarily used in warfare (archery and target rifle shooting), six came from work activities (rodeo and birling), and finally, twenty-two were left unclassified.

416 pages. $5.20. Mic 56-1423

ATTITUDES OF WOMEN STUDENTS TOWARD COLLEGE PHYSICAL EDUCATION

(Publication No. 16,369)

Sammie Rushing Hunter, Ed.D.
The University of Florida, 1956

This study was an attempt to gather and analyze attitudes of college women students toward physical education and to discover if possible causal relationships of other life experiences. A further purpose was to develop a scale for discovering and classifying attitudes of women students toward required college programs of physical education.

More specifically it was the purpose of the study to answer the following questions: (1) What were the stated attitudes toward physical education held by the women students enrolled in the required physical education program at the University of Florida; (2) Were there causal relationships between their stated attitudes and their record of achievement, their parent's occupation, their home life, their previous experiences in physical education, their opportunity to engage in sports and related activities in their home communities, the degree of achievement of certain developmental tasks, and certain factors involving "self"? (3) Was it possible to develop a useable scale for categorizing attitudes?

An instrument was prepared for eliciting the attitudes and factors within the physical education programs and in their backgrounds which it was believed might have a causal relationship to the formation of these attitudes. Completed questionnaires were returned by 687 women students enrolled in the Required Physical Education Program at the University of Florida. Some of the data collected by these questionnaires were treated statistically by using the Pearson Product Moment Correlation Technique, Thorndyke's Item Analysis, and Chi Square. Because there was an endeavor to individualize parts of the study some of the information gathered did not lend itself to quantitative analysis, but proved significant in verifying the statistical findings.

The following conclusions are justified by the summary of findings:

1. Lack of participation in community sports and recreational activities, being an only child, having mothers

who did not go to college, non-participation in sports and recreational activities with parents and family, attending other than large public high schools, starting to date early, having painful menstruation, non-participation in church social and recreational activities, and having no age mates to play with during childhood are some experiences that seem characteristic of girls who hold unfavorable attitudes toward physical education.

2. Many girls who dislike physical education in school prior to university shift to favorable attitudes during their college experiences in physical education.

3. Some girls who hold favorable attitudes toward physical education in elementary, junior high, and high school shift to an attitude that is unfavorable when they enter college.

4. Interested members of a family, who include young girls in their sports and recreational activities, promote a lasting favorable attitude toward these activities. Contrary to this the parents and families who did not participate with their children in sports and related activities, and discourage physical activities for fear of injuries or as detracting from femininity seemed to instill unfavorable attitudes toward physical education.

5. The students who suffer a feeling of insecurity in physical education classes are those who were often chosen last for team play; ashamed of their physiques; afraid of ridicule from their teachers and classmates; unaccepted by highly skilled students; and those who were afraid of being injured in some sports.

6. The implications, from the parts of the study that could not be analyzed quantitatively, are that there are many factors pertaining to physical education that are undesirable to both the girls who hold favorable attitudes and those who hold unfavorable attitudes toward this subject.

7. The majority of the derogatory factors are of a type that can be eliminated from the physical education programs. 153 pages. $1.91. Mic 56-1424

AN EVALUATION OF THE RECREATION PROGRAMS IN SELECTED SECURITY INSTITUTIONS OF OHIO

(Publication No. 15,860)

Howard Eugene Maurer, Ph.D.
The Ohio State University, 1955

The study represents an experimental approach to the measurement of selected prison recreation programs in Ohio.

The writer initially interviewed a jury of experts to help set up a list of five factors to be evaluated. The philosophy underlying the program, the personnel, the program, the facilities, and the outcomes composed the list of factors. Each of the five factors was assumed to be of equal weight in determining the total score for each institution evaluated.

The judging of each of the five factors was done by the use of a list of criteria, some of which were suggested by the jury. Other criteria were selected because they commonly appeared in authoritative writings.

Since the criteria used to evaluate the five factors were not equal in number, it was necessary to employ a conversion proportion. This reduced the various scores of the factors to a sum with the same relative weight.

The writer judged the various criteria through scores which ranged from one to five: 1, represented poor; 2, below average; 3, average; 4, above average and 5, maximum. These scores were then used to construct a series of profile charts which made it possible to note the points of relative strength and weakness in the institutional programs.

The writer was employed as recreation supervisor at Ohio Penitentiary for a period of one year. As a result he was able to obtain much first-hand information and some material that would not be available to an outside investigator. For example, the dissertation contains 12 photographs showing prisoners engaging in various forms of recreation. Special permission from the warden made this possible.

Personal letters were written to ten nationally known penologists who are particularly interested in educational programs for prisoners. The letters are reproduced in the appendix and provide an excellent source of information for those who are interested in the recreation or physical education field for prisons.

The dissertation contains many charts, some of which show the activities chosen by inmates in the gymnasium or recreation field over a period of time. The number and kind of injuries resulting from participation were charted. The need for specific game instruction and safety education is suggested. Gymnasium and athletic field layouts are shown through scale drawings.

The estimate of all prison service programs made by men due to be released on parole is shown in another chart. The information was obtained through the use of a score-card, check-list technique. Results indicated that field recreation rated highest among the men questioned. Block recreation rated near the bottom of the entire list. The gymnasium program was judged to be average.

The evidence obtained through this study supports the conviction of the writer that many immediate and remote educational objectives are obtainable through the medium of recreation. Such programs must be well planned and thoroughly supervised if the greatest good is to result. Loosely run recreational programs under the guidance of untrained personnel will result in some problems. Tensions will be increased, and undesirable outcomes will follow.

A common misconception seems to be prevalent among penologists. Evidence tends to show that some prison administrators conceive of recreation solely as a means of controlling prisoners — a custodial tool.

The bibliography which the writer developed from his sources of material should prove to be very valuable to anyone who is interested in recreation programs inside of prisons.

The state of Ohio is in the process of spending many millions of dollars for an improved penal system. More bricks and stones are not enough. This study should help to give better direction to the thinking of those who are responsible for the program which should function within Ohio prisons. 375 pages. $4.69. Mic 56-1425

THE COMPARISON OF TWO TEACHING METHODS ON LEARNING THE MECHANICS OF SELECTED BODY MOVEMENTS

(Publication No. 16,134)

Marjorie B. Tate, Ph.D.
State University of Iowa, 1956

Chairman: Associate Professor Margaret G. Fox

This investigation was conducted to compare two experimental methods of teaching body mechanics with a conventional method in order to determine whether learning could be improved. These two variables were a different method, the Kinesthetic Method, and a device, visual aids, added to the traditional way of teaching body mechanics. The latter, for the sake of brevity, will be referred to as the Visual Aids Method. The third method was the Conventional Method.

The criterion by which improvement was measured consisted of the use of judges' ratings which were based on a visual rating scale for both static and dynamic positions and movements. This scale contained a lantern slide for each event in the test except walking. Each portrayed excellent performance for the event and four common deviation patterns from this standard ranging from good to bad. The five point criterion was based upon verbal definitions of expert opinion.

Each subject was tested both before and after the methods were applied. Their performances were filmed as they were being tested. The test was composed of skills which were taught to all of the subjects. They included standing, walking, lifting, carrying, sitting, landing from jumping, stair climbing, pushing and pulling.

The judging was done as follows: as the film showing the subject's performance was reviewed, the criteria was shown beside the film slide by slide matching the event upon the screen. The judges looked from performance to criteria and then rated.

Three classes of body mechanics were used for the experiment. These classes were composed of freshmen women at the State University of Iowa who were below average in their body mechanics skills as judged in the freshmen testing program. To each class was assigned one of the three methods. The subjects were equated first on the basis of motor ability. The second and final basis was calculated on the performance of the pre-tests.

The content of the three classes was identical. It was selected after a careful study of textbooks written by recognized authorities in the area of body mechanics.

The methods may be briefly defined as follows: The Traditional Method consisted mainly of explanation, demonstration and practice along with normal usage of visual aids, kinesthetic cues and other appeals to the senses and brain processes. The Kinesthetic Method accentuated the appeal to one's conscious awareness of position and movement relationships. Cues designed to assist in recognizing sensations coming from the muscles, tendons, joints and pressure from the sole of the foot were used. They helped in identifying relationships of local segments to each other and to the whole body, and the body in turn to its environment. Normal amounts of explanation, demonstration and visual aids were used. The Visual Aids Method emphasized the use of visual aids: posters, charts, mirrors, skeleton, self posture silhouettes, illustrations, selected films and self performance films. The latter was the most used and was considered the most important visual aid. This method also contained normal amounts of explanation, demonstration and use of kinesthetic cues.

When the experiment was concluded, it was revealed that all three groups made significant gains in skill as measured by the comparison of performance in the pre and post tests. The Visual Aids Group made the most gains in both static and dynamic posture. The Control Group was next being slightly better than the Kinesthetic Group. All groups made significantly more gains in dynamic postures than in static posture. There was no significant difference between the three methods in improving their standing posture. The Visual Aids Group was significantly better than the Kinesthetic Group in learning dynamic body skills and was superior to the Control Group. There was no significant difference between the Kinesthetic and Control Groups in learning dynamic body skills. The criteria developed for measuring dynamic body skills had greater consistency than that for measuring static posture.

152 pages. $1.90. Mic 56-1426

EDUCATION, PSYCHOLOGY

SEMIOTIC AND THE PROMOTION OF THOUGHT BY TEXT QUESTIONS

(Publication No. 12,197)

Joseph Raymond Bailer, Ph.D.
New York University, 1955

Chairman: Professor Lou LaBrant

This inquiry is an application of semiotic to the questions in certain school texts in literature (ninth grade) for the purposes of finding the characteristics of a good question, of analyzing questions in use and of establishing a means of evaluating them. Such study involves examination of the language of the text questions to ascertain whether they direct pupil attention to critical thinking.

Since critical thinking is important in a democracy, the possible influence of the text question is evident. No research study of questions in terms of their language function has been found.

Text-book questions are stimuli for the verbalizations which call for critical thinking, the goal under investigation, as a step between question and answer.

Thirteen textbooks for ninth grade literature were used. These contained 4267 study questions.

Criteria for classifying the questions are derived from semiotic. Three categories of language are pointed in terms of the kind of intention they express:

1. The designative signification—always informs
2. The prescriptive signification—always prescribes actions to objects
3. The appraisive signification—always signifies the preferential status of objects.

A second type of categorization is of behaviors essential to critical thought, meaning:

1. To interpret data, which (ability) involves the ability to draw conclusions
2. To recognize the logic of an argument, which (ability) involves the ability to select from a list of major and minor premises in relation to stated conclusions
3. To distinguish between a fact from an assumption.

Two judges evaluated a sampling of the questions. Their judgments show significant agreement; and their judgments agreed significantly with the writer's.

Findings

1. Emphasis (68.5 per cent) in the questions is in the designative category.

2. A study of the prescriptive questions indicates that 0.135 per cent of the 244 prescriptive questions promoted critical thinking.

3. Analysis of the three types of question groups indicates that the appraisive question has more qualities of the "good" question. It is found that the appraisive text question promotes critical thinking of two types: (1) interpretation of data and (2) inferencing and drawing conclusions. Little attention is given to recognition of logic and distinguishing fact from assumption.

4. In the thought categories, 654 called for interpretation of data; 515 for inferences and conclusions; 115 for recognition of logic; 29 for distinguishing between fact and assumption.

5. A study of the patterns of the question groups indicates; (1) that the designative question is used first in question groups in 406 out of 515 groups and (2) that in only one book was there a developed relationship among the questions.

Recommendations

1. A further study of the appraisive question is recommended to determine the results of emphasizing it in developing critical thinking.

2. Experimental study should be made of the text selections as basis for promoting the kinds of thought processes the text editors and educators desire to be developed.

3. Further study is needed to ascertain the most desirable patterns of questioning.

4. Study should be made of the designative question to ascertain whether it generates expression indicating comprehension of the selection.

5. The use of prescriptive questions should be further explored.

6. It is recommended that questions which promote a recognition of logic and the distinguishing of fact from assumption be further studied.

7. It is recommended that the classifications from semiotic be used for classifying text questions.

The hypothesis upon which this study is based fails to be substantiated by positive results, indicating that the texts herein studied fail to a considerable degree to promote critical thinking. 100 pages. $1.25. Mic 56-1427

TWO EXPERIMENTAL FEEDBACK PROCEDURES: A COMPARISON OF THEIR EFFECTS ON THE LEARNING OF CONCEPTS

(Publication No. 16,386)

Gabriel Mario Della-Piana, Ph.D.
University of Illinois, 1956

Background and Aim. -- Results of research during the first three decades of the twentieth century established that learning may be enhanced by giving a learner knowledge of results of error responses. To simplify terminology, the phrase, "procedures for giving a learner knowledge of results of error responses" is replaced in this paper by the briefer and more generic term, "feedback procedures." Some theory suggests that feedback procedures enhance learning through influencing the subject's "searching orientation" -- that is, his active search for the reasons underlying a correct response. The present study was designed as a means of deciding whether this hypothesized "searching orientation" warranted further investigation. The study was also designed to compare the learning value of two feedback methods similar to those in actual use in classrooms.

Procedures. -- Two experimental feedback procedures were developed to produce variations in "searching orientation" of subjects. These procedures constituted our two experimental treatments: one (dependency treatment) in which a subject was immediately told the correct answer when he gave an incorrect answer, and the other (searching treatment) in which a subject was told to keep trying until he "discovered" the correct answer. Differences between treatments, other than the theoretically crucial difference, were minimized. The dependency treatment was assumed to induce the subject to look to the experimenter for the answer. The searching treatment was assumed to induce the subject to develop hypotheses as to why his responses were wrong. Heidbreder's inductive concept-formation task was used. This consists of associating nonsense-syllable names with plane figures where the concept to which the name belongs is in terms of shape, color, and number of the figures.

Hypotheses. -- The two main hypotheses of the study were: I. Searching-treatment subjects would learn to define more concepts than would dependency-treatment subjects. II. Searching-treatment subjects would learn to give the nonsense-syllable names of more concepts than would dependency-treatment subjects. The rationale for Hypothesis I is that the searching treatment, with its induced hypothesis-forming and testing activity, leads to more articulation of reasons for the correctness of a response. The rationale for Hypothesis II is that knowledge of definitions makes it easier to name a concept, without a lapse, in a variety of situations.

Results. -- Hypothesis I was supported by significant differences in the predicted direction. The direction of differences predicted in Hypothesis II was supported by the results, but the differences were not statistically significant.

Conclusions and Implications. -- The positive results with respect to the learning of definitions of concepts suggest the value of more intensive study of the psychological processes, searching and dependency orientations, presumably induced by the experimental feedback procedures. The non-significance of the prediction concerning the

naming of concepts may have been due to two variables which suggest further lines of research: (1) the range of concept attainment scores was seriously restricted, and (2) an association interference variable operated against the searching treatment subjects. Implications for teaching are not directly carried over from the study; however, an example is given concerning how results of the study may be used by teachers in their creative development of teaching methods. 88 pages. $1.10. Mic 56-1428

AN ANALYTICAL STUDY OF RESEARCH FROM 1904 TO 1954 ON LEADERSHIP DISPLAYED BY AMERICAN CHILDREN AND YOUTH

(Publication No. 16,359)

Cornelia Morris Lancaster, Ed.D.
The University of Florida, 1956

This study presented an analysis and synthesis of research on leadership displayed by American children and youth from the pre-school level up to and including the high school level for a period of fifty years, from 1904 through 1954. A few selected foreign studies were included for comparative and supportive purposes.

Preliminary reviews of the research were presented according to four main classifications comparable to age groupings: pre-school, elementary, junior high, and senior high levels. Within each classification the studies were presented in chronological order according to date of publication. The reviews contained data relative to investigators, problems, social composition of the samples, techniques, and results.

Analysis of the data was made in terms of distribution of studies, methodologies used, traits and characteristics associated with leadership, and environmental aspects influencing leadership. There were 64 investigations which met the criteria for inclusion in this study. The general distribution revealed a scattered pattern over the years with the majority of studies, 93 per cent, falling between 1920 and 1943. The methods used in the research literature were classified under seven general headings: observation, choice-making, use of case history, tests, questionnaires, interviews, and rating scales. In general, the problem to be solved, the social composition of the sample, and the situational factors involved determined the techniques best suited to a particular investigation.

A synthesis of the data revealed traits and characteristics found to be associated with leadership in children and youth. It was discovered that a majority of studies on leadership confined their examinations to certain physical, mental, personal, and social qualities possessed by pupils occupying positions of leadership.

The physical factors pointed up were chronological age, height, weight, physique or energy output, and appearance. The mental factors studied included intelligence, scholarship, knowledge, insight, judgment, and communication skills. A variety of terms used to describe personal factors associated with leadership were: originality, self-confidence, adaptability, responsibility, initiative, persistence, ambition, dominance, extroversion-introversion, and emotional control. Social factors involved social activities and social skills, namely, participation, sociability, cooperation, diplomacy, and tact.

Research evidence indicated that the situational and environmental settings bring to the foreground those qualities necessary for effective leadership. Leadership was investigated in many kinds of situations. There appeared to be a decided trend away from the early concept of leadership as dependent upon personal traits and characteristics toward the interaction approach which relates leadership directly to the group and its goals. There appeared to be a paucity of research using the interaction approach.

Evidence indicated that leadership can be identified at an early age, but the definition of what constitutes leadership differed with investigators. From the beginning of the formation of a group some individuals were found to take more active roles than others, to be preferred by other members, and to rise to higher status. This interaction or role assuming procedure within a group seemed to be the beginning of leadership differentiation and has been observed in groups from early childhood through later years.

Research findings indicated that the ability to initiate an activity and help a group move toward its goals is necessary for leadership behavior on any age level. Leadership is not acquired by the mere possession of traits, but is given by the group to the individual who is respected and is perceived as having those qualities necessary to help achieve goals. A leadership program in a democracy must focus attention on the growth and development of the members of the group rather than on the selection of a few individuals for leadership education.

189 pages. $2.36. Mic 56-1429

PSYCHIATRIC SOCIAL WORK SUPERVISORY RATING SCALE: A RATING SCALE FOR MEASURING MATURITY OF ATTITUDES OF PSYCHIATRIC SOCIAL WORKERS ABOUT THE CULTURAL, EMOTIONAL, INTELLECTUAL, AND PHYSICAL CHARACTERISTICS OF PATIENTS

(Publication No. 15,577)

Clarence Joseph Ryan, Ph.D.
New York University, 1955

This study deals with the construction of a scale which can be utilized by chief psychiatric social workers and psychiatric social work supervisors to objectively evaluate the maturity of attitudes of psychiatric social workers which are reflected in their written records of casework interviews about the cultural, emotional, intellectual, and physical characteristics of patients.

In solving this problem it is necessary to accomplish the following:

1. To validate the rating scale for maturity of attitudes of psychiatric social workers by the indirect method of relying on competent judgments.
2. To ascertain the cultural, emotional, intellectual, and physical characteristics of patients about which the maturity of attitudes of social workers affect the casework relationship.
3. To formulate a definition of maturity of attitudes of psychiatric social workers about characteristics of patients.
4. To ascertain the number of equal appearing step-intervals to be utilized in the scale.

5. To formulate descriptive definitions of the steps of the scale which proceed from the lowest level of maturity of attitudes to the highest level.

Responses to questionnaires from sixty-one judges* are used to find the answers to the above five sub-problems. To determine the objectivity with which the rating scale can be utilized it was subjected to an experimental application by thirteen judges to sixteen records of casework interviews. An advisory panel of three psychiatric social work supervisors and a psychiatrist worked with the investigator to analyze and rate seventeen records of casework interviews which were included in an eighty-two page manual and mailed to the judges participating in the experimental application of the rating scale for the purpose of providing the judges with training and a standard procedure in the use of the rating scale.

The results of the study are:

1. The mean of the proportions of judges who stated they agreed with a series of statements of writers in the field of social work who expressed their opinions as to the importance of the social worker's attitude in the casework relationship is ninety-two.

2. The mean of the proportions of judges who agreed on the component parts of the rating scale is eighty-one.

3. In the experimental application of the rating scale proportions of thirty-eight or more judges selected from one to four characteristics of patients about which they judged the social workers to be reacting. The mode for the number of characteristics selected is three.

4. In the experimental application of the rating scale proportions of thirty-eight or more of the judges rated the social workers as having either appropriate or relatively appropriate emotional reactions about characteristics of patients in ten of the cases, as having inappropriate emotional reactions about characteristics of patients in three of the cases and as having either appropriate or relatively appropriate emotional reactions about some characteristics of patients and inappropriate emotional reactions at levels three, two, and one of the rating scale about other characteristics of patients in three of the cases. Of these, the mean of the proportions of judges who rated the social workers as having appropriate or relatively appropriate emotional reactions about characteristics of patients is eighty-two and the mean of the proportions of judges who rated the social workers as having inappropriate emotional reactions at levels three, two, and one is seventy-two.

The general conclusion is that the responses of the judges concerning the rating scale allow us to assume that it is a valid instrument and that the proportions of agreement of the judges in the experimental application of the rating scale allow us to assume that it is a reliable instrument. 119 pages. $1.49. Mic 56-1430

*Chief psychiatric social workers or psychiatric social work supervisors.

RELATIONSHIPS BETWEEN COLLEGE PERSISTENCE (ATTRITION), FATHER'S OCCUPATION, AND CHOICE OF CURRICULUM

(Publication No. 16,426)

John Marlowe Slater, Ed.D.
University of Illinois, 1956

Many believe it is advantageous to our society that each individual achieve the fullest educational development of which he is capable. Although we recognize that all students who start college will not graduate, we do not always understand the differences between those who do and those who do not persist in their efforts to complete the prescribed courses which lead to a degree in a given college.

Hypotheses concerning certain of these differences have been drawn from a conceptual framework which is provided for the consideration of persistence and attrition. The conceptual development is based upon the assumption that attrition is, in part, the result of psychological satiation which occurs when the academic activities of the student take on the psychological characteristics of repetition; i.e., that of marking time as opposed to making progress.

It is proposed that the student's perception of curricular activity will be determined to a considerable extent by the attitudes and values which he learned before he entered college. These attitudes and values reflect a variety of influences of which the home is customarily one of the most significant. And, neighborhood in which the home is located, experiences of the children, behavior patterns which are taught, social class position of the family, etc. are frequently determined by the nature of the father's employment.

The major hypotheses concerning persistence of students at the University of Illinois are stated as follows:

1. When college and curriculum are not specified, male students whose fathers' occupations are classified as

Professional	Agricultural
Managerial	Skilled
Clerical and Sales	

will not differ in their rates of persistence.

2. For male students in the population being studied, persistence will be greater in curricula that have specific vocational objectives (e.g. curricula in the Colleges of Agriculture, Commerce, and Engineering) which can normally be achieved in four years than in curricula that are not oriented toward some relatively specific vocational goal (e.g. general curricula in the College of Liberal Arts and Sciences).

3. When male students are enrolled in a college which prepares them to enter occupations similar to those in which their fathers are employed, persistence will be greater than for others in the same college whose fathers are otherwise employed.

It is also hypothesized that

4. When predicted differences do occur in rates of persistence, these differences are not dependent upon aptitude, as measured by the ACE.

The population consisted of 1323 males who registered in one of the following colleges on the Urbana campus of the University of Illinois in September, 1950:

College of Agriculture
College of Commerce and Business Administration
College of Engineering
College of Liberal Arts and Sciences

In the summer of 1955 official University records were examined to determine whether each of these students had or had not graduated from (or, was or was not presently registered in) that college of the University in which he enrolled in 1950. The rate of persistence for any given group was expressed by the ratio

$$\frac{\text{Number of persistent students in category 'x', July, 1955}}{\text{Total number of students in category 'x', September, 1950.}}$$

Fathers' occupations were classified on the basis of categories provided in the Dictionary of Occupational Titles. Colleges were differentiated on the basis of their objectives as stated in the 1953-1954 catalog of the University.

Total raw score on the ACE was used to make chi square tests of the independence of aptitude and the variable(s) specified in the hypotheses.

Results indicated that, except for the first, each of the hypotheses might be accepted at the 5% standard of significance. When college and curriculum were disregarded, sons from farm homes persisted at a significantly higher rate than did sons from other occupational groups. This may have been accounted for, in part, by the fact that 61% of the sons of farmers were enrolled in the College of Agriculture where the rate of persistence for farm boys is relatively high. No other group showed such a concentration of enrollment in a single college.

Generally speaking, persistence was greater for men enrolled in curricula whose vocational implications are obvious and relatively immediate than for men enrolled in curricula which lack specific vocational objectives. Persistence was greatest when the vocational orientation of the college was a familiar one, i.e., when the college prepared men to enter occupations similar to those in which their fathers were employed. The influence of the determinants - father's occupation and vocational objectives in the curricula - seemed not to be dependent upon ACE scores which fell in the range reported in this study. When the curricular orientation was a familiar one, persistence was independent of ACE scores which fell in the range reported in this study.

The conceptual framework was useful in the generation of hypotheses for this study. In addition, the conceptual development suggests other hypotheses concerning differences between students who do and students who do not persist in their efforts to graduate from a given college.

98 pages. $1.23. Mic 56-1431

EDUCATION, TEACHER TRAINING

RECONSTRUCTION OF THE UNDERGRADUATE PROFESSIONAL COURSES IN AGRICULTURAL EDUCATION AT THE UNIVERSITY OF TENNESSEE

(Publication No. 16,381)

Rufus Wilford Beamer, Ed.D.
University of Illinois, 1956

Purpose.-(1) To determine the strengths and weaknesses of the current undergraduate professional courses in Agricultural Education; (2) to establish the duties, responsibilities and opportunities of teachers of vocational agriculture; (3) to develop appropriate general and special objectives in professional agricultural education; (4) to suggest learning experiences that would enable students to accomplish the stated objectives; (5) to decide on sequence and placement of learning experiences; (6) to establish time allotment for experiences; (7) to establish evaluative criteria and procedure for learning experiences; (8) to determine a general methodology of teaching; and (9) to establish guidance functions and procedures.

Method.-Selected literature on curriculum development was reviewed. The objectives of this review were (1) to identify some major concepts and practices in the field of curriculum development, and (2) to synthetize these findings into a set of guiding principles for use in making this study. Principles were developed in the following areas of curriculum construction: Definitions and limitations; objectives and evaluation; determining content; determining sequence of experiences and courses; methods of instruction; and guidance and counseling.

Data for the study were collected from several sources. The writer interviewed school officials, high school teachers, high school principals, and laymen in six selected public school systems in Tennessee. The interviews had two major purposes: (1) To get information to assist in defining the job of the teacher of vocational agriculture, and (2) to gather evidences reflecting strengths and weaknesses in the professional training of teachers of vocational agriculture.

Two questionnaires were administered to selected high school principals and teachers of vocational agriculture. Supervisors of vocational agriculture, supervisors of student teachers, teacher educators, and student teachers completed certain sections of one of the questionnaires. One questionnaire was designed to provide data on the importance of certain abilities in teaching vocational agriculture, and the other to uncover weaknesses in the current program of professional agricultural education at The University of Tennessee. A third questionnaire was administered to high school students in vocational agriculture to determine how they felt about their programs.

Findings and Interpretations.-The people interviewed were almost unanimous in their beliefs that community programs of agricultural education should include instruction for high school boys, young farmers, and adult farmers. With few exceptions, they would limit the enrollment in high school classes to students who have access to farming facilities, and who are interested in farming as an occupation.

Ability areas rated as essential or desirable for teaching vocational agriculture by a high percentage of respondents were as follows: (1) Ability to establish and maintain

relationships; (2) ability to determine community agriculture needs; (3) ability to prepare an agricultural education program; (4) ability to establish and maintain an advisory council; (5) ability to provide and maintain departmental facilities; (6) ability to teach high school classes in vocational agriculture; (7) ability to direct programs of supervised farming; (8) ability to direct programs of farm mechanics; (9) ability to advise a Future Farmers of America Chapter; (10) ability to provide guidance to students; (11) ability to organize and conduct young and adult farmer classes; (12) ability to continue professional growth.

Based on the data of this study, the following courses in agricultural education are proposed for students at The University of Tennessee (credit is in quarter hours):

(1) 2--. Introduction to Agricultural Education. (Two hour elective)

(2) 3--. Supervised Farming and the Future Farmers of America. (Three hours credit)

(3) 3--. Methods and Facilities in Teaching Vocational Agriculture. (Three hours credit)

(4) 3--. Organizing and Teaching Young and Adult Farmer Courses. (Three hours credit)

(5) 4--. Supervised Teaching in Agricultural Education. (Nine hours credit)

(6) 4--. Developing a Program of Vocational Education in Agriculture. (Six hours credit)

Two courses in Education: Educational Psychology (three hours credit) and Principles and Organization of Secondary Education (three hours credit) complete the proposed professional education sequence for prospective teachers of vocational agriculture.

285 pages. $3.56. Mic 56-1432

THE RELATIONSHIP BETWEEN THE DOMINATIVE-SUPPORTIVE DIMENSION OF PERSONALITY AND STUDENT-TEACHERS' CLASSROOM BEHAVIOR

(Publication No. 16,005)

Dorothy Nelson Candland, Ed.D.
Stanford University, 1956

The Problem

Most educators agree that the schools' objectives cannot be fully realized unless the classroom atmosphere is supportive and non-threatening for children. Recent investigations have shown that the teacher's personality will greatly affect the emotional climate of the classroom. It was the purpose of this study to investigate the relationship between one facet of student-teachers' personalities, the dominative-supportive dimension, and the social-emotional atmosphere they create for their pupils.

Working Hypotheses

The "dominative" student-teachers (those who score high on the F Scale and low on the MTAI) will tend to verbalize on a more "teacher-centered" level than will the "supportive" student-teachers (those who score low on the F Scale and high on the MTAI), whose verbalizations will tend to be more "learner-centered."

The "supportive" student-teachers will predict the sociometric status of their pupils more accurately than will the "dominative" student-teachers.

Research Design and Findings

Two tests, the MTAI and F Scale were used to identify the "dominative" and "supportive" groups from the extreme high and low scores of a sample of ninety-five elementary education seniors at the Brigham Young University. These groups, composed of eighteen subjects each, were observed in student-teaching situations by a research team of six university faculty members and a public school supervisor, working in pairs. The team used a technique developed by Withall for assessing classroom climate by classifying verbalizations in seven categories along a learner-centered to teacher-centered continuum. A minimum of 300 verbalizations were categorized for each of the thirty-six subjects, and the Social-Emotional Climate Indices were computed using the following formula:

$$\text{S-E C Index} = \frac{\text{Sum of statements in Categories 1, 2, and 3}}{\text{All recorded statements}} \times 100$$

The First Hypothesis was tested by categorizing the Indices, (according to whether they fell below or above the mean Social-Emotional Climate Index for both groups) in the following four-fold contingency table:

	Learner-centered	Teacher-centered
Supportive Group	16	2
Dominative Group	2	16

The testing of the null hypothesis yielded a chi-square[1] of 18.683, clearly significant at the .001 level. Because of the low cell frequencies in this case, exact probability was also computed:

$$P = \frac{(a+b)!\ (c+d)!\ (a+c)!\ (b+d)!}{N!\ a!\ b!\ c!\ d!}$$

The probability value obtained was less than .001. The .05 level was used as the criterion level in all tests.

The Second Hypothesis was examined through the use of teacher estimates of pupil sociometric status. In using this technique, it was assumed that a rank correlation[2] of the teacher's prediction of the acceptance-rejection pattern in the classroom and pupils' own friendship choices would reveal the extent to which a teacher understands the social structure of his class. The data obtained show that the rhos were surprisingly high. The mean rho for the "supportive" group is .869, only slightly higher than the mean rho (.859) for the "dominative" group. When the difference between these co-efficients was tested, using Fisher's z transformation, a t of .615 was obtained. This did not reach significance at the criterion level, and the null hypothesis cannot be rejected with warrantable confidence.

Conclusions

The data obtained in this study appear to support the following conclusions:

1. Student-teachers who scored low on the MTAI and high on the F Scale tended to verbalize on a teacher-centered level. Student-teachers who scored high on the MTAI and low on the F Scale tended to verbalize on a learner-centered level.

2. The MTAI and F Scale are effective predictive measures of how the social-emotional climate (as assessed by the Withall technique) will be influenced by student-teachers' verbalizations.

3. The MTAI and F Scale do not significantly discriminate between student-teachers who are accurate in their judgment of pupil sociometric status and student-teachers who are less accurate in their perception of the social structure of their classes.

147 pages. $1.84. Mic 56-1433

1. $X^2_y = \frac{(ad - bc - N/2)^2 N}{(a+b)(a+c)(b+c)(c+d)}$.

2. $\rho = 1 - \frac{6 D^2}{N (N^2 - 1)}$

A STUDY OF THE PROBLEMS OF BEGINNING ART TEACHERS AS RELATED TO LEARNING EXPERIENCES IN THE METHODS COURSES AND IN STUDENT TEACHING AT INDIANA UNIVERSITY

(Publication No. 11,198)

Martha Rebecca Carter, Ed.D.
Indiana University, 1955

Chairman: William H. Fox

The improvement of teaching throughout the history of modern education has been of primary concern to educators. There has been, however, comparatively little research concerning the improvement of the teaching of art in the elementary and secondary schools.

The purpose of this investigation was to determine the relationship between problems encountered by a selected number of beginning art teachers and the learning experiences offered in the art methods courses and in student teaching at Indiana University.

The data collected for the study of this problem consisted of (1) interviews with the 30 beginning art teachers in the state of Indiana who were graduated from Indiana University during the years 1950, 1951, and 1952, and with twelve beginning art teachers who were graduated from other institutions; (2) interviews with the administrators or supervisors of each of these beginning art teachers; (3) an interview with the assistant director of student teaching at Indiana University; and (4) an attempt by the investigator, as a former instructor in art methods at Indiana University, to determine as objectively as possible the emphasis which had been given in the methods courses in art to the problem areas encountered by the beginning art teachers.

Of the 79 problems named as most important, 63 involved difficulties in relation to room, facilities, equipment, and supplies; discipline; instructional difficulties; or excessive teaching load.

The beginning art teachers reported a total of 406 problems in specific areas. One hundred seventy-two were concerned with instruction and classroom management; 83 were due to shortages and limitations of materials and physical equipment; 77 were related to instructional materials and audio-visual aids; 57 were concerned with the teacher's extra-class relationships with pupils and his relationships with fellow teachers, administrators, and the community; 12 were encountered in the area of the teacher's professional growth; and 5 fell in the area of the second teaching subject.

Seven problems were found to be common to one fourth or more of the teachers. These problems were as follows: lack of ideas for art activities, insufficient time to plan, discipline, distribution and care of materials, grading, limited storage space, and limited equipment.

The administrators of these teachers reported a total of 152 problems. Of these, 56 were concerned with instruction and management; 39 were concerned with physical conditions, materials and supplies, instructional materials, and audio-visual aids; 36 arose through the teacher's relationships with pupils, other teachers, administrators and community; and 21 referred to areas about which the beginning art teachers themselves were not questioned, such as educational goals, professional zeal, and school policy.

In relating the problem areas to the content of the art methods courses, it was found that more adequate treatment was needed in at least some aspects of each of the following areas: curriculum, planning, classroom management and control, teaching techniques, evaluation, art supplies and instructional materials, teacher relationships, and community relationships.

In considering the relationship of the problem areas to student teaching, more adequate treatment was needed in the following areas: planning, classroom management and control, evaluation, teacher-pupil relationships, and community relationships.

Recommendations were concerned with the revision of the requirements for the training of art teachers at Indiana University. In general, these included: strengthening the student's preparation for teaching at the elementary level by the inclusion of (1) a study of child development, and (2) studying the content and organization of the curriculum of the elementary school as a basis for planning the art program. It was further recommended that graduate study be begun during the first year of teaching, during which time the beginning teacher would work under the cooperative guidance of school authorities and university personnel. 168 pages. $2.10. Mic 56-1434

THE DEVELOPMENT OF A GUIDE IN TEXTBOOK FORM FOR IMPROVING THE SKILL OF PROSPECTIVE TYPEWRITING TEACHERS IN TEN ESSENTIAL AREAS

(Publication No. 15,543)

Robert Lee Ferguson, Ed.D.
New York University, 1955

The problem of the investigation was to discover areas in which prospective typewriting teachers need to increase their skill, and to prepare a guide in textbook form for improving their skill in certain of the areas.

Nineteen areas in which the typewriting teachers of Western Illinois believe they should have greater skill were compiled from interviews and a questionnaire submitted to them by mail. The nineteen areas were reduced to ten essential areas upon recommendation of a jury of twelve experts made up of leaders in Business Education who are both typewriting textbook authors, and experienced typewriting teacher trainers. The ten essential areas were as follows:

Error analysis and error elimination
Electric typewriters
Speeding up production typewriting
Feeling for style in typing unarranged material
Care, cleaning and oiling the typewriter
Composing at the typewriter
Typewriter parts vocabulary
Handling rough drafts
Manipulating little used typewriter parts
Changing typewriter ribbons

Each of the above areas meets the criterion: Provision for increasing skill in the area can be made in the typewriting class utilizing the typewriter and typing materials.

The following nine areas were not included because they could best be provided for in some way other than in a typewriting class:

Demonstration typewriting
Preparing tests
Giving direct dictation
Making simple repairs and adjustments
Preparing stencils and masters
Handling school newspaper production
Handling school yearbook production
Make-ready operations in typewriting
Breakdown of operations into steps for drill

From additional data secured from typewriting teachers in Western Illinois; from recommendations made by the jury of experts; from writings in the field; and from the writer's background of knowledge and experience; a guide for improving the skill of prospective typewriting teachers in the ten essential areas was prepared. The guide is the primary result of the study. The guide is in textbook form and has the following chapter titles:

Manipulation of Little Used Typewriter Parts
Vocabulary
Care and Cleaning
Letter Production Improvement
Tabulation Production Improvement
Speeding up Other Kinds of Production Work
Error Analysis and Elimination
Composition at the Typewriter
Feeling for Style
Rough Drafts
Changing Typewriter Ribbons
Electric Typewriting

Each chapter in the textbook provides teaching materials for classwork and laboratory work in the form of drills, problems, projects, and informational material.

That there are many areas in which prospective typewriting teachers need to improve their skill is a conclusion of the study. The ten essential areas represent the needs that can be provided for in a typewriting course. Other needs should be provided for in some other way—perhaps in a methods course.

It was recommended that the needs in the ten essential areas disclosed by this study be provided for in a typewriting class utilizing the materials which are a part of the document.

Similar studies should be made of the unique needs in other areas of business teaching, such as shorthand, bookkeeping, and general business, and provision made for meeting the needs discovered.

285 pages. $3.56. Mic 56-1435

THE EXPANDING ROLE OF CREATIVITY IN AN ELEMENTARY SCHOOL

(Publication No. 15,872)

Lorrene Love Ort, Ph.D.
The Ohio State University, 1955

This is an investigation, projected among children in an elementary school, of that intangible and expanding force called creativity, which, when quickened and stimulated by such assisting catalyzers as challenge, spontaneity, inspiration, and an objective touch of greatness — to name a few — seems to cause the human yeast to exert and extend itself into an upsurging commotion that finally becomes manifest in that unique way which is identifiable in its external expression as being a true product of personal creativity.

Procedures used include: reviewing pertinent literature — past and contemporary; using past and present personal observations; drawing on sources of children's creativity — using photographs of some children's art work from an elementary school, describing some children's reactions to creative situations, noting some of the comments made by children during or concerning the creative process, and using other forms of children's creative expression.

The field is one in which there is need for more exploratory work in which assumptions and hypotheses can be clarified. To the extent of reviewing much of that which is known and written about in this area — and to the extent of coupling what is in print with much personal observation and exploration in this field — the study is scientific, but the full proof — if such there may be — is not yet evident.

An approach to the gaining of insights into the "What is it?" and "What nurtures its development?" questions concerning the creative potential is made in a twofold manner — through the analysis of the process given by very creative people and by conditions perceived to be beneficial in developing this creative yeast.

In focusing on the psychological setting for the creative act, these are the creative aspects of learning considered:

inspiring so that children may aspire; capitalizing on the interrelated aspects of the arts; seizing creative moments and building on them; and stimulating through the freshness of new materials.

In exploring channels to creative expression, concepts favorable for integrative learning in the elementary school are reviewed, and further consideration is also given to how these channels may be opened, expanded, and more closely related.

Some inertnesses, blockings, and frictions that make creativity miss, and which are in themselves unfavorable to integrative learning in the elementary school, are delineated. Conversely, however, the positive values of creative action are shown to provide a salvaging potential even for negative situations.

Recognition of some areas of expression that offer certain recurrent creative opportunities for elementary school children is another phase treated and illustrated at length.

The study suggests that the following are positive channels through which schools may develop the creative potentials in children:

--to build in happiness, schools must provide opportunities to let out the creative desires of children through vital experiences.

--to nurture creativity, schools need to provide challenging and tempting fare for all children.

--to provide experiences that are rich in the creative potential, learning must be cued to that "best" which is known about a child's developmental and ongoing readiness.

--to foster creativity in children implies that there must be concern not only for individuality but also for the needs of many children.

--to recognize that creativity is not a forced knowledge but a "becoming" state.

--to meet the challenge that in the creative classroom children and teachers alike stretch their sights and extend their reach to seek untold "heavens."

--to exult in the knowledge that creativity is to all men given, and, for children, this means that not one or some but that "Ev'ry little soul must shine, shine, shine!"

319 pages. $3.99. Mic 56-1436

A STUDY OF CERTAIN ASPECTS OF TEACHER EDUCATION IN WISCONSIN

(Publication No. 16,208)

Wilson Erwin Schwahn, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Arvil S. Barr

Problem

A study of certain aspects of teacher education in Wisconsin was undertaken to determine present conditions, practices and trends. The discovery and clarification of problems and issues, as well as proposed solutions, was also undertaken.

Procedure

The criterion for analyzing teacher education programs was the practicing teacher's competence in toto. Teacher activities were identified as competencies, personal qualities or behavior controls. These were then classified according to major aspects of the educational process, including classroom management, personal-professional relationships, pupil health and development, etc.

A survey questionnaire was designed to enable teacher educators to analyze their own work and the teacher education program in their respective institutions. On this form, the respondents indicated their judgments as to the emphasis they give and plan to give the various aspects and activities, their value to the practicing teacher, and the responsibility for training in them of the pre- and in-service programs. The respondents also described their actual practices in furthering student achievement of the criteria and classified these practices by degree of effectiveness. Finally, the respondents presented specific suggestions for improving their respective institutional teacher education programs.

Results

The respondents indicated marked emphasis was currently given Educational Psychology, General Education, Professional Relations, Classroom Management, and Pupil Health and Development. Moderate emphasis was indicated for Educational Methods, Curriculum, Philosophy, and Guidance. Limited emphasis was indicated for Community Relations, Tests, Measurement and Evaluation, and School Organization, Practices and Support.

Generally, the respondents indicated continuation of the emphases indicated above but, specifically, to increase emphasis on General Education, Educational Methods, and Guidance, and to decrease emphasis on Tests, Measurement and Evaluation.

Pupil Health and Development, General Education and Educational Psychology were judged by the respondents to be of maximum value to the practicing teacher, Classroom Management to be of moderate value, and Philosophy, Educational Methods, Community Relations, Tests, Measurement and Evaluation, and School Organization, Practices and Support to be of limited or minimum value.

The pre-service program was judged to be currently responsible for preparing teachers, whereas such training should be the joint responsibility of the pre- and in-service programs.

The respondents indicated that using problem solving, critical thinking or reasoning, serving as action-model and contributing to development of the professional program were effective practices. Practices considered to be ineffective, lacking or in need of improvement, were those of providing experiential activities, detecting and dealing with individual differences, contributing to development of total program, using appropriate instructional methodology, evaluating and improving the educational situation, having adequate instructional aids, and integrating discrete elements.

Major improvements suggested for institutional teacher education programs in Wisconsin were those of integrating courses, fields and programs, raising standards of scholarship and of student selection and retention, providing experiential activities, educational aids, two years of general education before specialization, and special professional services for practicing teachers, adding interneship-type fifth year, and increasing and equalizing different degree offerings and training programs.

Conclusions

The foundational or core elements of the teacher education program should include those of general intellectual and cultural development, psychology of growth, development and learning, methodology of guiding and directing development and learning, and professional development and relations.

Preparing teachers should be the joint responsibility of both pre- and in-service training programs and should include experiential activities, interneship-type transitional training, advanced in-service training, and adequate educational aids and surroundings.

Cooperative action should be undertaken by all faculty members to expand the concept of teacher education, integrate courses, fields and programs, raise the quality of the teacher education program, and establish intra- or inter-institutional in-service training programs for teacher educators. 468 pages. $5.85. Mic 56-1437

THE TEACHING OF SCIENCE IN ELEMENTARY SCHOOLS BY RECENT GRADUATES OF ATLANTIC CHRISTIAN COLLEGE AS RELATED TO THEIR SCIENCE PREPARATION

(Publication No. 16,364)

Jesse Parker Tyndall, Ed.D.
The University of Florida, 1956

The problem for this study was to investigate and to evaluate the science teaching of recent elementary graduates of Atlantic Christian College and to examine the science program provided at the college for prospective elementary teachers.

The first step in the study was to devise means of evaluating science practices of elementary teachers. A checklist of characteristics of a good elementary science program was constructed, including sixty-one items grouped into the following categories: physical facilities, relations with children, type of program, type of experiences, evaluation of the program, and understanding of subject matter. This checklist was submitted to twenty specialists for rating. On the basis of the items deemed essential by the specialists the following instruments were constructed: an observation checklist, an interview checklist, and a questionnaire.

Forty recent elementary graduates of Atlantic Christian College were selected to participate in the study.

Two main procedures were followed. One was to scrutinize the high school and college records of the teachers and to determine what science was taken, how much was taken, and the achievement of these teachers in their courses. The second was to observe and evaluate the science teaching in the classrooms of the recent graduates by using the various checklists. Five additional questions were asked in the interview.

From the data obtained, within the limitations of the study, it seems that the following recommendations for the preparation of elementary teachers in science at Atlantic Christian College are warranted:

1. The college program should continue to stress the biological sciences in order to provide its prospective teachers with an understanding of the biological world necessary for working effectively with elementary school children.

2. The science program should continue to make use of materials from the environment of prospective teachers in order to encourage the continuation of this practice in elementary classrooms.

3. The science program should continue to encourage students to use the scientific method of problem-solving in order to develop skills and attitudes essential to teaching science to children.

4. Since high school and college records indicate that the teachers have had very little physical science, and since very little physical science was taught by the teachers, it appears that Atlantic Christian College should provide experiences in the physical sciences. This is important because many of the materials and devices of modern civilization are based upon the application of physical sciences.

5. The preparatory work for prospective teachers should be strengthened to include the following in order to prepare teachers to develop adequate science programs in their classrooms:

Aid in the development of ingenuity to manipulate a classroom into a laboratory-like atmosphere.

Preparation which would give insight into the variation in maturity levels of elementary school children.

Broad principles and generalizations, so that teachers can aid their children in understanding scientific principles and the relationships between the physical and biological sciences.

Experiences in the use of comprehensive evaluation.

Preparation providing teachers with information concerning the obtaining and use of pamphlets in their programs.

Experiences which would make students aware of the wealth and accessibility of community resources and resource persons.

Provide more experiences dealing with professional content, science content, methods, and materials.

Provide experiences which would help the teachers to understand elementary school children better.

6. The college should not shift its responsibility for the preparation of elementary teachers in science to in-service experiences and other experiences.

144 pages. $1.80. Mic 56-1438

EDUCATION, THEORY AND PRACTICE

THE DEVELOPMENT OF A HANDBOOK IN GROUP DYNAMICS TECHNIQUES FOR COLLEGE TEACHERS OF CERTAIN BUSINESS SUBJECTS (PARTS I AND II)

(Publication No. 15,540)

Richard Sorensen Dale, Ed.D.
New York University, 1955

The Problem

Training men and women for business administration careers must include training for human relations,

because human relations skill is a vital part of all business endeavors.

Definitions and Delimitations

Group dynamics may be defined as the ever-present field of forces brought about by interpersonal relations within a group.

For this investigation, the study of group dynamics is defined as a study of the interaction among the members of groups so as to help groups determine and move toward mutually satisfying goals.

The term, group dynamics techniques, as used herein, refers to methods by which teachers and students can make use of the knowledge, insight, and understanding of human relations gained through the study of group dynamics.

This investigation was limited to a study of six group dynamics techniques:

1. Use of student committees;
2. Group discussion and student discussion leaders;
3. Group self-evaluation;
4. Dramatic role-playing;
5. Use of group observer; and
6. Teacher-student planning.

The investigation was further limited to uses of these techniques for such college business administration theory courses as business law, introduction to business, accounting, and management and distribution courses, specifically omitting such skill courses as typing and shorthand.

Related Literature

In surveying the literature on group dynamics, special emphasis was given to:

A. Basic principles underlying group dynamics study;

B. Group dynamics teaching techniques; and

C. Group dynamics techniques as used in business administration.

The accompanying bibliography lists the most important of the works studied.

The Need for the Study

The need for the study is twofold.

In the first place, there had been no other handbook developed especially for college business teachers which presented group dynamics techniques in a unified way.

Secondly, there seemed to be a definite need for a study of the criticisms—favorable and unfavorable—leveled at group dynamics techniques as they are now being used, by students as well as teachers.

Procedure

The document consists of two parts, THE INVESTIGATION and THE HANDBOOK.

Described in the first section are the procedures followed in developing the handbook. Two methods of study, besides the study of related literature described above, were employed. (A) Eighteen college teachers who had had wide experience in the use of group dynamics techniques were visited on their own campuses for interviews, in the states of New York, Michigan, California, Louisiana, and Georgia. (B) A questionnaire was used for gathering information and opinions about group dynamics teaching techniques from 555 college teachers and students.

The second section presents the findings of the study.

Conclusions

In this study the following broad general principles emerged:

1. Man is a social animal; his learning is enhanced as it is tied in with his social propensities . . .
2. Man is a self-directing animal. Organizing effort proceeds most successfully when the individuals being organized have a voice in determining the direction of such endeavor.
3. Full communication of ideas among all members of a group is preferable to hierarchical communication "from the top down."
4. An integration of the viewpoints of all persons concerned, incorporating the best thought of each individual, is preferable to the imposing of the will of a person in authority, or even to the enforced overriding of a minority by a majority.
5. Cooperation is at least as important as competition to the business administrator.

It is concluded that, when college business students are treated in the light of the democratic philosophy THE HANDBOOK sets forth, advantages accrue both to the efficiency of the group and to the human-relations skill of the individuals so treated—in the classroom group and in their business lives as well.

214 pages. $2.68. Mic 56-1439

A STUDY OF METHODS FOR TEACHING RAPID LEARNERS IN SECONDARY SCHOOL SCIENCE

(Publication No. 15,593)

Robert Rymal Donaldson, Ph.D.
Cornell University, 1955

Chairman: Philip S. Johnson

This investigation is designed to examine the motivational factors which impel students toward a science career and the educational methods which are considered appropriate for teaching talented students in science at the secondary level.

Literary source materials were used to determine the intellectual climate which is most conducive for stimulating further studies in science. A survey consisting of thirty methods for teaching science at the secondary level was sent to a group of science teachers for an evaluation of recommended use on a NONE, SOME, or MUCH basis. Control groups consisting of college scientists, secondary science-supervisors, science-educators, and recently graduated high school science-students responded to the same questionnaire. Contrasts of response for each procedure were made by comparing mean levels of recommended use and coefficients of rank correlation, rho (ρ), for the thirty items.

The judgments of the specialized groups were closely correlated to one another but the science-teacher response was more similar to a report of use made on a previous U. S. Office of Education survey* of the thirty item procedures. In most instances the recommendations of the

science-teacher group were more similar to the judgments of the control-group than were the reports of use in the earlier survey.

The conclusions which can be made are:

(1) The most promising source for an increased potential of scientists is the reserve of high ability students who do not as yet attend college.

(2) The optimum environment which fosters high ability scientists is marked by strong hereditary and cultural backgrounds.

(3) Talented science students possess a high general intelligence supplemented by various configurations of aptitude and interest.

(4) Superior science students should be given more rigorous training, either through acceleration or enrichment, than students of less ability.

(5) There are wide variations of judgment in selecting educational methods for use with rapid learners of science but those which place responsibility of action on the student are most acceptable (projects, reports, assist in demonstrations or laboratory, et cetera).

(6) The capable science teacher should be enthusiastic for science showing enterprise in selecting a variety of educational provisions in inspiring, encouraging, and stimulating superior students toward high academic performance in science.

(7) High ability science students are able critics of teaching procedures as shown by a high correlation with judgments of professional control groups.

The unifying emphasis is expressed by the higher standards of achievement expected of superior science students and the assumption that they will bear greater responsibility in science activities.

247 pages. $3.09. Mic 56-1440

*Bulletin 1954, No. 5 - U. S. Department of Health, Education and Welfare, Office of Education, "Teaching Rapid and Slow Learners in High School."

TEACHING COMPOSITION IN THE SEVENTH GRADE

(Publication No. 16,007)

Sister Mary Leonella Moe, Ed.D.
Stanford University, 1956

The purposes of this study were: (1) to describe a method of teaching composition developed by the Sisters of the Holy Cross, and (2) to evaluate the method through the use of equivalent groups.

The investigation tested these hypotheses:

1. that a method of teaching composition may be devised that will equip students with the fundamental skills in writing,
2. that one method may be more successful than another in equipping students with these skills.

Procedure

The control group was formed from five classes of seventh-grade pupils taught by the Sisters of the Holy Names in Oregon. Comparable groups were chosen from classes taught by the Sisters of the Holy Cross in California and Utah. One hundred seventy-four pairs of pupils were tested in October, 1954, and April, 1955.

The pupils were asked to write about problems in human relations. A rating scale was devised for the use of the judges based upon the Willing Scale in Composition. The ratings were made by teachers of the seventh-grade from the public schools of Menlo Park and San Mateo in California.

In order to test the reliability of the rating scale, twenty-five percent of the papers in April were re-scored by the writer in both content and form values, and coefficients of reliability were computed (content, .84; form, .88).

A coefficient of correlation was computed between the form value and the total numerical errors (.55). There was a correlation of .96 between content and form values.

Findings

In order to evaluate the results of the experiment, the answers to two questions were sought:

1. What were the differences between the groups in October, 1954?
   a. Difference in content value
   b. Difference in form value

The difference in content and form values in October, 1954, were measured by computing the means, standard deviations of the means, the standard deviation of the differences of the means, the standard errors of the differences, and the "t's," which were significant at the .001 level of confidence. The significance was in favor of the experimental group.

2. What was the difference in the change made in each group between October, 1954, and April, 1955?

The differences in gain in content and form values in April, 1955, were measured by computing the mean differences, the standard errors of the differences, and the "t's," which were significant at the .01 level of confidence. The significance was in favor of the experimental group.

Conclusions

The average gain of the experimental group in both content value and form value in written composition from October, 1954, to April, 1955, was significantly greater than the average gain of the control group on the same test. This significant difference supports the conclusion that the method of teaching written composition which has been developed by the Sisters of the Holy Cross can be used effectively with seventh-grade pupils to help them gain skill in written expression.

The answer to both problems of this study is a clear affirmative. 168 pages. $2.10. Mic 56-1441

AN EXAMINATION OF FACTORS PRESENT IN SUPERIOR HIGH SCHOOL ATTENDANCE

(Publication No. 12,227)

Margaret M. Mullin, Ph.D.
New York University, 1955

Chairman: Professor William D. Wilkins

The Problem

This study had as its purpose the discovery and examination of factors associated with superior high school attendance. The specific problems were:

1. the selection of three groups markedly different in attendance achievement;
2. the study of characteristics related to the personal and social functioning of the three groups;
3. the discovery of those discriminatory factors that identify superior attenders specifically.

Procedure

To determine the criteria for the three groups, the absence totals of the school population (3200) for the fall term were tabulated. Superior attenders were absent no day (seventy-four students); average attenders absent five or six (sixty-two students); poor attenders absent thirteen or more days (fifty students). One hundred eighty-six tenth grade students of a comprehensive metropolitan high school were the subjects of the study.

The three groups were compared on attendance and health record, intelligence quotient, ratio of promotion, scholastic achievement, socio-economic status, attitude toward home and school, personality traits and temperament.

The mean, standard deviation and critical ratio for the difference of means were computed for the following:

I.Q. (Henmon Nelson Group Test)
Ratio of promotion (majors passed to majors taken)
Scholastic average
Total number of days absent
- a. Grades 3, 4, 5, 6
- b. Grades 7 and 8
- c. Grades 3-8
- d. Grades 9 and 10
- e. Grades 3-10

Score on Bell School Inventory
Score on Stott Home Life Scale
Total score, two partial scores, twelve sub-test scores, of the California Test of Personality
Total score, two partial scores and ten sub-test scores of the Mental Health Analysis
Thurstone Temperament Schedule - seven trait scores
Descriptive Rating Scale - nine ratings by teachers

The significance of the differences in the replies made by the three groups on five hundred fifty-two items in the several inventories was determined by the chi-square technique.

Warner's Index of Status Characteristics was used to assess socio-economic standing. Independent ratings of four factors, occupation of father, source of family income, house and neighborhood type, were made, weighted and translated into a social class designation by two members of an investigating team.

Results

The superior attenders of this study were superior attenders during every stage of school life. The absence pattern established in Grades Three through Six, superior attenders least absence and poor attenders greatest, was maintained thereafter.

Superior attenders achieve higher scholastic averages without a corresponding differential in scholastic ability. They are more generally approved by teachers who assign to them the higher character ratings.

Superior attenders reveal a positive, satisfied attitude toward school and participate in extra-curricular activities to a greater extent.

The superior attender comes from a home of higher socio-economic standing and is a member of a smaller family in which the parents have more formal education.

Conclusions

Since superior attendance is achieved under favorable circumstances—with no or only a few deterrents, a definite motivation toward school, and a satisfying measure of achievement and approval—the school will encourage regularity of attendance by improving the conditions under which a student attends.

248 pages. $3.10. Mic 56-1442

STUDENT SUCCESS IN A STATE TEACHERS COLLEGE AND THE DISTRIBUTION OF SOCIAL CLASS STATUS

(Publication No. 12,245)

Durlyn E. Wade, Ph.D.
New York University, 1954

Introduction:

The major hypothesis stated that: the distributions of academic grades received by students in "Keystone Teachers College", plus the amount of participation in college activities, when placed in association with social class status are biased in favor of the upper social classes.

Design:

A form of null hypothesis was accepted and statistically examined by use of tables of contingency and chi square analysis. The criterion of statistical significance was set at the five per cent level.

The theory of proportionate distributions was assumed. To illustrate its operation: if ten per cent of the students were in the lower social class, then the lower social class would be expected to receive ten per cent of the high grades; ten per cent of the low grades; ten per cent of the offices in clubs; ten per cent of the memberships in honor societies, and so forth.

The I.S.C.[1] method for stratifying the sample of 419 students according to social class was selected from a study of several widely accepted approaches. In turn, the social class distribution was statistically compared with the distribution of representative rewards of both an academic and non-academic nature. The term rewards was interpreted to include punishment in so far as being denied reward is accepted as a form of punishment.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

Summary of the Findings:

1. When academic grades were distributed proportionately in terms of social class status, and the differences between the distributions compared, (actual versus theoretical) a bias was found favoring the upper social classes. The chi square was statistically significant beyond the one per cent level in support of the hypothesis.
2. When the social acceptance scores women received from men were placed in association with social class the results were statistically significant beyond the one per cent level. The hypothesis was supported. When social acceptance scores within the same sex, and scores for men from the opposite sex were similarly tested the hypothesis was not supported.
3. When the number of offices held in student clubs were placed in association with social class status the resulting chi square was statistically significant beyond the one per cent level. The hypothesis was supported.
4. In isolation certain comparisons between participation in college activities and social class produced negative results. When the total pattern of student participation in college activities was placed in association with social class the results were statistically significant at the one per cent level. The total pattern of student participation supported the hypothesis.
5. When dismissal from college, selection of students as student counselors, and selection of students for special recognition were statistically compared with the distribution of social class the results were negative. The hypothesis was not supported in these cases.
6. Other factors were compared with the distribution of rewards to see whether any of these were equal in importance to social class. The results showed that social class was, by and large, the more important independent variable associated with the rewards tested.

Conclusions:

1. With very little doubt the distribution of academic grades in "Keystone College" is biased in favor of the upper social classes.
2. With very little doubt the social acceptance scores received by women from men in this sample are biased according to social class.
3. With very little doubt the total pattern of student participation at "Keystone College" in extracurricular activities is biased according to social class.
4. Although social class was shown to be statistically independent of certain other factors social class probably does not operate alone in association with the biased distribution of rewards students receive at "Keystone College."

339 pages. $4.24. Mic 56-1443

1. W. L. Warner and Associates, Social Class in America. Chicago: Science Research Associates. 1949.P.v-274.

ENGINEERING, AERONAUTICAL

ON THE NONEXISTENCE OF LIMITING LINES AND BERGMAN'S LINEAR OPERATOR METHOD IN DIABATIC FLOWS

(Publication No. 16,399)

Hassan Ahmad Hassan, Ph.D.
University of Illinois, 1956

The hodograph method is extended to diabatic flows, i.e., flows with heat addition (or subtraction) due to heat sources (or sinks) distributed in the flow. The basic equations describing the behavior of the diabatic flow are the ordinary hydrodynamic equations for an inviscid, nonheat conducting, perfect gas in a steady irrotational flow and the first law of thermodynamics. The function describing the heat added (or subtracted) per unit mass is assumed to be a given function of the independent variables. This function, together with its derivatives up to the required order, is assumed bounded.

A prominent feature of the flow is furnished by considering stream tubes: Sonic conditions do not necessarily occur at the throat, but the governing differential equation changes its character from elliptic to hyperbolic. Due to this, the regions in the flow are designated by elliptic and hyperbolic and the line separating them is called the parabolic line.

First, a proof of the nonexistence of limiting lines is given. It is shown that a limiting line cannot appear in a plane continuous flow past an airfoil or inside a nozzle of bounded curvature if the flow depends continuously on the velocity (or Mach number) and has a bounded hyperbolic region. However, if the profile has an infinite curvature at some point then a limiting line appears.

The behavior of the flow near the transition line in a two dimensional Laval nozzle is discussed next. By a suitable transformation the problem is reduced formally to a similar problem discussed by Falkovich for isentropic flows. Therefore, all the formal results obtained by Falkovich hold for this case.

Finally, Bergman's linear operator method is extended to diabatic flows in the elliptic domain. By a suitable transformation, the stream function equation is reduced to a form similar to that in isentropic flows. Following Bergman, v. Mises and Schiffer, the stream function is

represented as an infinite series and the region of uniform convergence is determined. Determination of some functions which appear in the method is included and their behavior near the parabolic line is discussed. The discussion is concluded by some remarks on the boundary value problem. 76 pages. $1.00. Mic 56-1444

ENGINEERING, CHEMICAL

A THEORETICAL DISCUSSION OF STEADY AND UNSTEADY STATE MULTICOMPONENT RECTIFICATION INCLUDING A TREATMENT OF MIXTURES WITH AN INDEFINITE NUMBER OF COMPONENTS

(Publication No. 15,970)

Andrew Acrivos, Ph.D.
University of Minnesota, 1954

Adviser: Neal R. Amundson

The steady-state rectification of multicomponent mixtures is one of the oldest and, at the same time, one of the most important problems in chemical engineering. Due to its complexity, said problem has not been completely solved, but nevertheless, considerable progress has been made in that direction and many of the factors which influence the operation of a column are beginning to become clearer and to be understood.

The present dissertation is entirely theoretical. It deals with a number of mathematical models which, experience has demonstrated, describe, in many cases, the behavior of the actual system with satisfactory accuracy, and serves two purposes:

a. To summarize briefly, and in many instances to improve on, the work already published in the literature, and

b. To solve new problems, primarily those concerned with the rectification of mixtures with an indefinite number of components and the transient behavior of a distillation column.

In the first part of this work then, i.e. Chapters II-VII, few new results are obtained; in most cases, however, the technique of deriving the various formulae already reported in the literature is, on the whole, original. On the other hand, the results presented in the remaining part of this thesis are new.

This dissertation can be divided up into four sections. The first, Chapters II-VIII, is restricted to the steady-state rectification of mixtures with a finite number of components; the second, Chapters IX-XV, deals with continuous and semi-continuous mixtures; the third, Chapter XVI, is devoted to some illustrative numerical examples; and the last section, Chapter XVII, deals with the unsteady state behavior of a distillation column.

Extensive use is made in this work of a mathematical model known as the "ideal plate" column, and the equations which describe the behavior of said model have been solved analytically for even the most general kinds of mixtures. In addition, the minimum reflux problem has been considered in some detail, and a solution was obtained in closed form, again for even the most general kinds of mixtures. The significance of the two "key components" at minimum reflux has also been discussed.

Analytic solutions to more complicated models have also been obtained by approximate, yet standard, methods. The bulk of the numerical calculations were made with the aid of the IBM 602A DC, and the necessary wiring diagrams as well as instructions are included in this thesis. Finally the unsteady state behavior of a distillation column is examined with the aid of a simple model which is believed to be accurate enough for most practical applications. 375 pages. $4.69. Mic 56-1445

TEMPERATURE PROFILES IN PACKED BEDS OF CATALYST DURING REGENERATION

(Publication No. 16,174)

Benjamin Martineau Johnson, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor C. C. Watson

Equations for the transient temperatures along the center line of a fixed-bed reactor have been developed for adiabatic operation and for the case in which the bed is losing heat to an isothermal coolant. It is assumed in both cases that reaction components are continuously removed from both the fluid flowing through the bed and the solid particles making up the bed. Such a situation would exist during the regeneration period of a fixed-bed catalytic reactor.

These equations are, for the adiabatic operation,

$$T = \frac{Q\frac{M_c}{M_g}p_o}{C_p(1-B/C)}\left[\frac{1}{1+\exp(A\ell-B\Theta)}-\frac{1}{1+\exp(A\ell-C\Theta)}\right]$$

and for non-adiabatic operation

$$T = \frac{Q\frac{M_c}{M_g}p_o}{C_p(1-B/C)}\left[\exp(A\ell-C\Theta)\right]^{D/(C-B)}\begin{cases}\exp(A\ell-C\Theta)\\ \dfrac{X^{D/(B-C)}}{(1+X)^2}\,dX\\ \exp(A\ell-B\Theta)\end{cases}$$

where $A = k\pi(M_c/M_g)(\rho_s/G)$
$B = k\pi(M_c/M_g)(C_p/C_s)$
$C = k\pi(p_o/c_o)$
$D = ha_s/a_c\rho_s C_s$
Q = heat of combustion of solid reactant (carbonaceous deposit)
M_c = molecular weight of the deposit
M_g = mean molecular weight of regeneration gas
ℓ = length down the reactor from beginning of bed, ft.
Θ = time from start of reaction, hrs.
k = kinetic rate constant for the equation $\partial c/\partial\Theta = k\,p\,\pi\,c/c_o$
π = total pressure, atmospheres
c, c_o = instantaneous and initial carbon concentration, per cent carbon

p, p_o = instantaneous and initial oxygen concentration, mole fraction
ρ_s = bulk density of bed, lb./ft.^{3}
G = mass velocity of reaction gas lb./hr.,ft.^{2}
C_p, C_s = mean heat capacity of gas and solid respectively, Btu/lb.,^{0}F
h = hypothetical heat-transfer coefficient based on the temperature difference between the center of the reactor and the coolant
a_s = surface area of the reactor exposed to coolant, ft.^{2}/ft.
a_c = cross-section of reactor, ft.^{2}

The following assumptions are made in the derivation of these equations.

1) The gas and solid are at the same temperature at any point in the column.
2) The conductive heat transfer in the direction of gas flow is neglected.
3) The rate of combustion of the deposit is expressed by the equation $\partial c/\partial \Theta = k\, p\, \pi\, c/c_o$; k is independent of temperature.
4) The properties of the gas and solid are constant throughout the reactor.
5) All resistance to heat transfer from the center of the bed is located at the wall of the reactor.
6) The bed, reaction gas, and isothermal coolant are all initially at the same base temperature.

The experimental system included a fixed bed of solids consisting of 1/8-inch alumina pellets packed to a depth of about five feet in a one-inch diameter reactor. The isothermal cooling of the reactor was supplied by a molten-salt mixture circulated through the annulus surrounding the reactor. The base temperature of the reaction and the temperature of the circulating salt was 900^{0}F. The carbonaceous deposit was formed by the thermal decomposition of a sugar solution absorbed by the solid pellets.

The practical applicability of the second equation, that for non-adiabatic operation, for predicting the center-line temperatures in a small fixed-bed reactor has been demonstrated over the following range of conditions:

c_o	1% - 4.3%
p_o	1% - 21%
G	250-1300 lb./hr.,ft.^{2}

No test of the adiabatic equation was possible because of the unavoidable heat loss from the reactor to the insulation.

The assumptions made in the development of the equation, concerning the mechanism of combustion of the deposit, were confirmed by data obtained from a series of experiments carried out in a separate differential reactor. The reaction rate was dependent on the first power of the oxygen concentration and approximately the first power of the fraction of carbon remaining and was only slightly dependent on temperature.

277 pages. $3.46. Mic 56-1446

THE EFFECT OF WATER VAPOR ON THE CATALYTIC OXIDATION OF NITRIC OXIDE

(Publication No. 16,181)

Omer Kircher, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Olaf A. Hougen

The purpose of this investigation was to establish quantitatively the effect of water vapor on the rate of catalytic oxidation of nitric oxide using activated carbon and silica gel as catalysts.

The experimental work was done in an isothermal, series-integral, flow reactor. A convenient photometric method of analysis for the oxidation product, nitrogen dioxide, was employed. The water vapor content of the feed stream was monitored by a continuously recording dew point hygrometer.

The following ranges of conditions were covered in the study:

total pressure	1 to 2.5 atm
nitric oxide concentration	2.4 to 4.6 mole %
oxygen concentration	about 20 mole %
temperature	30^0, 45^0, and 60^{0}C
dew point of feed	-35^0 to 27^{0}C
conversion of nitric oxide	0 to 98 %

The experimental evidence indicates that the catalytic oxidation of nitric oxide on both activated carbon and silica gel occurs by a single-site mechanism through the following sequence of steps:

(1) formation of a nitric oxide dimer in the gas phase

$$2\ NO \rightleftharpoons (NO)_2$$

(2) activated adsorption of the nitric oxide dimer

$$(NO)_{2(gas)} + (\text{active site}) \rightleftharpoons (NO)_{2(ads)}$$

(3) surface reaction of adsorbed dimer with oxygen in gas phase

$$(NO)_{2(ads)} + O_{2(gas)} \rightleftharpoons NO_{2(ads)} + NO_{2(gas)}$$

(4) desorption of the product nitrogen dioxide

$$NO_{2(ads)} \rightleftharpoons NO_{2(gas)} + (\text{active site})$$

The surface reaction between the adsorbed dimer of nitric oxide and molecular oxygen in the gas phase is the apparent rate-controlling step. The other steps are assumed to be at equilibrium.

The results of this study also indicate that water vapor retards the catalytic rate of oxidation by reversible adsorption on the active surfaces of the catalyst. The activity of the catalyst is not affected. The effect of water vapor on the rate of the catalytic reaction agrees qualitatively with known adsorption phenomena.

For activated carbon below a relative humidity of 0.2 the data indicate reversible, monomolecular-layer adsorption of water vapor. Above a relative humidity of 0.2, however, the degree to which water vapor retards the catalytic rate of reaction increases very sharply. This result suggests blocking of the interior catalyst surface by capillary condensation as is known to occur in the adsorption of water vapor by activated carbon.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

In contrast, on silica gel the effect of water vapor varies linearly with the partial pressure of water vapor over the entire range studied. Also, at different reaction temperatures the effect on the reaction rate at equal relative humidities is quantitatively the same. Both these results conform with the behavior of the water vapor-silica gel system.

The catalytic rate of reaction is expressed by the following equation:

$$r = \frac{p_{NO}^2 \; p_{O_2}}{a + b\, p_{NO}^2 + c\, p_{NO_2} + w\, p_{H_2O}}$$

where r = catalytic rate of reaction, moles of nitric oxide reacted per unit mass of catalyst per unit time

p = partial pressure of the subscript component

a,b,c,w = temperature dependent constants.

165 pages. $2.06. Mic 56-1447

THE EFFECT OF ORIENTATION AND ASSOCIATION IN THERMAL DIFFUSION

(Publication No. 16,406)

Walter Steven Kmak, Ph.D.
University of Illinois, 1956

The concentration dependence of the experimental values of the thermal diffusion coefficient for a series of binary solutions of associated liquids were found to be in good qualitative agreement with those predicted from a general theory developed from the thermodynamics of irreversible processes and the rate process theory of viscous flow.

The associated binary solutions investigated were: ethanol-water (25° C), methanol-water (40° C), diethylamine-water (49° C), diethylamine-ethanol (50° C), and triethylamine-ethanol (50° C). The cells used were of the two-chamber convection-free type. The aqueous solutions of alcohols showed a reversal of the direction of separation at low alcohol concentrations, indicating a complex mutual association which hinders the movement of the larger alcohol molecules.

For a general theoretical development, a treatment of thermal diffusion by thermodynamics of irreversible processes in volumetric coordinates is shown to yield the following equation for predicting α, the thermal diffusion coefficient:

$$\alpha = \frac{\frac{\bar{V}_1 \bar{V}_2}{\bar{V}} \left[\frac{\bar{Q}_1^*}{\bar{V}_1} - \frac{\bar{Q}_2^*}{\bar{V}_2} \right]}{x_1 \frac{\partial \bar{\mu}_1}{\partial x_1}}$$

where $\bar{Q}_i^*$ and $\bar{V}_i$ are the net molar heat of transport and the partial molal volume, respectively, of component i; $\bar{V}$ is the average molar volume of the solution; and $\bar{\mu}_1$ and x_1, the chemical potential and mole fraction, respectively, of component one. The theoretical work of de Groot (4) and Prigogine (5), based on a barycentric coordinate system, can be shown to be equivalent to the above expression by a suitable transformation of the net heat of transport to volumetric coordinates. The kinetic theory of Prigogine (6), corrected for differences in molecular volumes, is shown to reduce to a similar expression for α, except that $x_1 \frac{\partial \bar{\mu}_1}{\partial x_1}$ is replaced by RT. The experimental results of this work and the work of several others (1, 2, 7) indicate that $x_1 \frac{\partial \bar{\mu}_1}{\partial x_1}$ gives the correct concentration dependence of α.

Although the net heat of transport can be expected to be a very complex function for associated systems, entropy effects appear to be dominating so that it was possible to show good agreement by substituting activation enthalpies for viscous flow from Eyring's rate process theory (3). The earlier results of Dougherty (1) and Winter (7) for normal liquids had shown that activation enthalpy densities calculated from the viscosity data of the pure components agreed quantitatively with the experimental values. For associated systems the agreement was not satisfactory but a quantity defined as the partial molal activation enthalpy, $\overline{\Delta H}^{\ddagger}$, gave the correct concentration dependence for α, although its magnitude was much too large. The pressure coefficient of viscosity at constant volume (enthalpy for hole formation or local expansion), $\Delta H_h^{\ddagger}$, appears to be a much better estimate of the net heat of transport and good quantitative agreement is obtained for α for both normal and associated solutions. In order to predict the correct concentration dependence, however, it is proposed that a quantity defined as the partial molal enthalpy for local expansion, $\overline{\Delta H}_h^{\ddagger}$, be evaluated from viscosity-pressure-composition data.

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124 pages. $1.55. Mic 56-1448

A STUDY OF THE KINETICS OF IRON OXIDE REDUCTION

(Publication No. 15,981)

Wallis Allen Lloyd, Ph.D.
University of Minnesota, 1954

Adviser: Professor Neal R. Amundson

SUMMARY

A vertical flow reactor was constructed for the purpose of carrying out kinetic studies on the reduction of finely divided iron oxides in the presence of various reducing gases. The reactor consisted of a nine foot long, one inch inside diameter Vycor glass tube which was maintained at reaction temperature by means of external electric heaters. The reducing gas and the oxide, which was entrained in the gas by elutriation from a fluidized bed located below the reactor, were passed cocurrently upward through the heated reactor tube. The extent of reduction was calculated from a chemical analysis of the total iron in the reduced product.

Many of the experimental variables associated with the operation of the reactor were thoroughly studied to determine the magnitude of their effect on the measurements. It was decided from these studies and as a consequence of the rather good reproducibility of the data that the reactor is capable of providing reliable information on the kinetics of iron oxide reduction.

A large portion of the experimental work was concentrated on measurements of the rate of reduction of pigment grade Fe_2O_3 in hydrogen. The most interesting observation in these studies was that the reduction takes place essentially stepwise from hematite to magnetite after which further reduction must proceed apparently after initiation at new active centers on the magnetite surface. Of additional interest was the occurrence of a rate minimum at 600°C.

Several groups of experiments designed to measure the temperature coefficient of the reaction and the effect of variations of the total pressure and mole fraction of the reducing agent on the reduction rate were not considered adequate to definitely establish the rate controlling mechanism of this system. However, the latter could prove very useful if additional data were taken.

Particularly at the lower temperatures employed in this work, the curves resulting from the plot of per cent reduction as a function of time exhibit an S-shaped contour. Two theories were developed which could reasonably account for this phenomenon, although sufficient evidence is lacking to definitely determine which one is more nearly correct.

A portion of the work was directed toward a study of the reducibility of taconite magnetic concentrate with hydrogen. Better than 90% reduction of this material was accomplished at 600°C. A marked decrease in the reduction rate was observed when the temperature was raised from 600°C. to 700°C.

A small amount of the wustite phase was detected by x-ray analysis in samples of hematite and magnetite reduced at 450°C. in hydrogen. This was an unexpected development since the wustite phase is unstable below 570°C. It is possible that the wustite phase appears as an unstable intermediate in the reduction mechanism at the lower temperatures.

Several experiments were performed for the purpose of obtaining some information concerning the applicability of this reduction scheme to a commercial process. It was observed that certain features of the method may prove to be advantageous on an industrial scale, so that this type of reactor may prove useful for the concentration or complete reduction of finely divided ores.

180 pages. $2.25. Mic 56-1449

KINETICS OF THE CATALYTIC DEHYDRATION OF ALCOHOLS

(Publication No. 16,195)

Donald Nelson Miller, Ph.D.
The University of Wisconsin, 1955

Supervisor: Assistant Professor Robert Stewart Kirk

The catalytic dehydrations of the primary alcohols n-butanol, n-propanol and ethanol to produce water and the respective olefin, have been studied at three temperatures, covering the range 400 - 700°F. At each temperature, data have been taken at three pressures covering the range atmospheric to 100 psig. The catalyst used was silica-alumina in bead form, -4-6 Tyler Mesh. Catalyst activity was found to drop off to a significant degree with prolonged usage. Regeneration with steam, air or mixtures of steam and air did not restore the catalyst to consistent levels of activity. Fresh catalyst was therefore periodically charged. All dehydration data were corrected for loss in catalyst activity with use and for variations in activity between different batches of catalyst.

The amount of dehydrogenation was checked periodically by analyzing the products of dehydration for aldehydes. Dehydrogenation was found to occur to a minor extent. Some evidence of cracking and polymerization of the olefins produced in dehydration was found. No ethers were detected.

It was found that the rates of dehydration were controlled by a single site, surface reaction, chemical mechanism, on which was superimposed the influence of a diffusion effect internal to the catalyst pellets. By a trial and error procedure, the four constants of the rate expression—effectiveness factor, surface reaction rate constant and reactant and product adsorption constants —were determined. The effectiveness factors exhibited an increase with increasing pressure. The surface reaction rate constants showed the following order of reactivity:

ethanol < n-propanol < n-butanol.

The rate constants appear to approach a limit as the length of the alcohol alkyl chain increases. Differences in activation energies and activation entropies among the three alcohols contribute roughly to the same degree to the differences in the reaction rate constants. The magnitudes of the reactant adsorption constants appear to follow the carbon-oxygen bond strengths relative to that for ethanol. The adsorption constants for water, determined from the kinetic measurements of the three dehydration systems, appear consistent within the limits of accuracy of the experimental method.

186 pages. $2.33. Mic 56-1450

ISOTHERMAL VAPOR-LIQUID EQUILIBRIUM DATA FOR THE SYSTEM ETHANOL-n-HEPTANE OVER THE TEMPERATURE RANGE 135.5°C TO 194°C

(Publication No. 16,290)

Morris Newman, Ph.D.
Columbia University, 1954

Isothermal vapor-liquid equilibrium data were determined for the system ethanol-n-heptane over a temperature range from 135 to 196°C, at pressures ranging from 90 to 400 psia. Four isothermal sets of data were obtained, at 135.5°C, 147.7°C, 169.0°C, and 194.0°C.

A static equilibrium cell was used for the experimental measurements. Pressures were measured with a dead-weight piston gage to one psia. Temperatures were measured with a chromel-alumel thermocouple. A Leeds and Northrup portable precision potentiometer yielded emf measurements such that the temperatures could be estimated to within 0.05°C. Vapor and liquid samples were removed from the equilibrium cell by displacement with mercury. In this way, isobaric conditions were maintained within the cell during sampling. In order to establish that the equilibrium state within the cell had not been disturbed during the sampling, consecutive vapor samples were obtained. After discarding the first two or three of these samples of condensed vapor, six consecutive two c.c. samples were analyzed refractometrically. The fact that these samples were all of the same composition gives a positive indication that the equilibrium state within the cell had not been changed by the gradual removal of the vapor phase. Following the complete evacuation of the vapor phase, the liquid phase was removed at an elevated pressure, in order to prevent flashing. Consecutive samples of the liquid were also collected and analyzed. The refractometric analysis yielded composition data to within 0.001 mole fraction.

The resultant equilibrium data were analyzed empirically and thermodynamically. It was possible to fit the empirical equation of Prahl to the data with an average arithmetic deviation of 0.0021 mole fraction, thus indicating a satisfactory degree of internal consistency among the experimental measurements. However, it was impossible to apply the Gibbs-Duhem equation to the experimental data. The degree of uncertainty concerning the computation of the fugacity of the n-heptane precluded the drawing of any conclusions based on a thermodynamic analysis of the results. 168 pages. $2.10. Mic 56-1451

LIQUID-PHASE TURBULENT MIXING PROPERTIES

(Publication No. 16,574)

John Michael Prausnitz, Ph.D.
Princeton University, 1955

This thesis is concerned with fundamental studies in fixed-bed reactors. The first chapter describes an instrument for measuring concentration fluctuations in a turbulent fluid. The second chapter presents a theory of turbulent concentration fluctuations and reports measurements of such fluctuations. The third chapter presents an analytical solution for a very rapid first-order reaction accompanied by turbulent diffusion and reports mass transfer data for the dissolution of a sparingly soluble solute in a fixed bed reactor.

The method for measuring turbulent concentration fluctuations is based on the principle that the electrical conductivity of a solution is a function of its composition. A calibrated cell measures the conductivity of a small volume surrounding a fixed point in the turbulent fluid. The output of the cell is fed into suitable electronic apparatus. Mean-square and mean-absolute-value concentration fluctuations are measured. This technique is a new approach to the experimental study of turbulence in liquids.

A theory of concentration fluctuations is developed using a modified form of Prandtl's mixing length theory. The theory is based on a mechanism of fluid displacement or "jumps." The small masses of fluid which displace one another at a fixed point are not all of the same concentration; a concentration fluctuation results whenever a fluid mass of one concentration displaces a fluid mass of another concentration. It is assumed that the instantaneous concentration of a fluid mass is equal to the time-average concentration associated with the coordinates from which the fluid mass "jumped" and that the distribution of "jump distances" is normal. These ideas are applied to a tubular packed bed with a point source and it is shown that for points not near the center nor the tube wall the r.m.s. concentration fluctuation is proportional to the radial distance, to the time-average concentration and to the scale of turbulence which is defined as an "average jump distance." The theory is generalized for all geometrical arrangements.

Turbulent concentration fluctuation measurements are made for a tube packed with small spheres. Water is the primary fluid and a hydrochloric acid-methanol mixture of unit specific gravity is the tracer. Measurements at various Reynolds Numbers are reported for two particle sizes and four bed heights. The fluctuations are independent of the Reynolds number and for the region not near the center nor the tube wall they are proportional to the radial distance and to the time-average concentration. From these measurements the scale of turbulence is calculated to be about one-quarter of a particle diameter. Measurements made in the region where the effect of the tube wall is important are in good agreement with predictions of the generalized theory. Measurements made at the axis of the bed indicate anisotropy of turbulence; the scale of turbulence parallel to the tube axis is about five times that perpendicular to the axis.

An analytical solution is presented for a rapid first-order chemical reaction accompanied by turbulent diffusion in a packed bed with the controlling reactant entering from a point source.

Mass transfer data in a packed bed are presented for the turbulent dissolution of acetyl chloride from acetone into water. The mass transfer coefficients obtained are much larger than those commonly observed in standard extraction equipment. 150 pages. $1.88. Mic 56-1452

KINETIC STUDY OF THE REACTION BETWEEN SODA-LIME-SILICA GLASS AND WATER

(Publication No. 16,435)

Franklin Fu-Yen Wang, Ph.D.
University of Illinois, 1956

The specific aims of this study were to ascertain the identities of the products of reaction between soda-lime

-silica glass and water through indirect means; to assign the proper roles of reaction products; to affix the rate-controlling processes in the reaction; and to suggest a plausible mechanism of the reaction between glass and water.

The products of reaction between soda-lime-silica glass and water were found to be sodium metasilicate, calcium metasilicate, and metasilicic acid.

These reaction products serve to control the hydroxyl concentrations in the liquid. The products themselves do not react with the glass directly.

Rate-controlling processes in the reaction are the diffusion of sodium ions from the glass and the extraction of silicates through the breakdown of glass network. The rate of diffusion of sodium ions is accelerated by the sodium ion concentration gradient between the solid and liquid phases. The rate of extraction of silicates is accelerated by the hydroxyl ion concentration in the solution. Hydroxyl ion concentration is in turn governed by the amounts of reaction products in the solution.

Both processes result in the extractions of sodium, while extraction of silicon and calcium is accomplished through breakdown of the glass network as the major process.

The scope of this study was limited to the reaction between a soda-lime-silica glass and water for a constant time period for four hours.

67 pages. $1.00. Mic 56-1453

ENGINEERING, CIVIL

RURAL HIGHWAY CLASSIFICATION AND EVALUATION PROCEDURES FOR INDIANA COUNTIES

(Publication No. 16,446)

John Edward Baerwald, Ph.D.
Purdue University, 1956

Major Professor: K. B. Woods

The purpose of this study was to develop rational procedures for the classification and evaluation or priority rating of rural county highways in Indiana. A pilot study was conducted in Allen County, Indiana. Benefits resulting from the application of such procedures include: the assembly of relevant facts in an orderly manner; the elimination or minimizing of personal judgments in the assignment of priority of improvement; the provision of an objective basis for meeting community and political pressure; the provision of an average measure of the adequacy of the existing rural county highway plant and an indication of the progress in highway development; and the protection of the public's investment in the highway system by providing a method for budgeting funds according to the relative order of need.

All procedures proposed in this study were designed to satisfy the basic criteria of simplicity, practicality, flexibility, and economy. Procedures are presented for the classification of the rural county highways into three systems: County Primary, County Secondary, and Local Service. This classification is based upon knowledge of traffic volumes and characteristics, abutting land use, and community interest for both present and future conditions. Recommendations and methods for obtaining this information are also described, and detailed highway inventory procedures are discussed.

The study proposes a method of highway evaluation to establish an impartial priority value which portrays the relative needs of the various highway sections. Priority is based on the formula:

$$\text{Priority Rating} = 2.5\ (\text{Service Rating})^{1.25} \operatorname{Log}\left(\frac{100}{\text{Road Rating}}\right)$$

where the Priority Rating has a practical range from one to 100 with a high value indicating a high priority. The Service Rating ranges from one to a maximum value of 50 and is composed of various elements which indicate the need for or use made of a highway section. The Road Rating ranges from one to a maximum value of 100 and is composed of various elements which indicate the physical condition of the highway section. It is believed that this Priority Rating formula is one of the first, if not the first, rational procedures to be based on the interrelationship between the need for the highway and the physical condition of that highway. This mathematical relationship was recommended for use in Indiana Counties and it has the following properties which were deemed desirable:

1. Roads which provide a minimum service should have a Priority Rating which approaches a minimum value regardless of condition.
2. Roads which are ranked near the maximum as to condition (i.e. high Road Rating) should have a Priority Rating which also approaches a minimum value regardless of the service provided by that road.
3. For a constant Service Rating the rate of change of the Priority Rating should decrease as the Road Rating increases.
4. For a constant Road Rating, the rate of change of the Priority Rating should increase as the Service Rating increases.

In addition to recognizing the desirability of incorporating cost values in the application of highway evaluation, the study also includes a discussion of some of the highway rating procedures now being used by various states and counties and compares these procedures with the proposed Priority Rating method. A rather comprehensive bibliography is also included.

155 pages. $1.94. Mic 56-1454

SPECIAL TECHNIQUES FOR STUDYING FLUID FLOW, WITH SOME APPLICATIONS TO CORNER FLOW

(Publication No. 16,336)

Ralph Koliner, Ph.D.
University of Pennsylvania, 1956

Supervisor: Robert Lowy

In this investigation an attempt was made to obtain directly actual streamlines and local velocities of flow by the injection of colored tracer droplets at regular intervals into a flow system, and taking still camera photographs of the flow. However, it was found that even in a relatively simple flow system, the individual fluid particles themselves do not follow a streamline, but that only the average of many individual "pathlines" will constitute an average streamline. Therefore individual suspended droplets will trace separate pathlines and the average of many of these lines would constitute an average streamline.

In certain examples of flow where only a small deviation exists between pathlines and streamlines it is also possible to approximate the local velocity by measuring the distance between consecutive tracer droplets.

Another technique, that of having long strings suspended in the flow, while also not wholly accurate as a flow indicator, was nevertheless found effective as a means of comparing similar patterns of flow.

Results of both techniques as obtained in closed transparent models of square cross-section having 90^0 corners were compared with mathematically computed potential streamlines for these examples of corner flow and with a set of streamlines obtained by the use of an electrical analogy. Photographs show that the theoretical, mathematical and graphical analyses agree with the general trend of flow up to a certain cross-section, beyond which the effects of separation, turbulence, vortices and secondary flow lead the droplets into flow patterns not predictable today by analytical means.

In a supplementary investigation, it was demonstrated that in the viscous flow range the injected droplets follow along the same flow lines as the parent stream.

135 pages. $1.69. Mic 56-1455

AN ITERATIVE PROCEDURE FOR THE SOLUTION OF A LARGE NUMBER OF SIMULTANEOUS LINEAR EQUATIONS

(Publication No. 16,422)

Arthur Richard Robinson, Ph.D.
University of Illinois, 1956

This study is concerned with the solution of large systems of linear equations which often arise in the solution of engineering problems. Special consideration is given to those sets of equations which result from finite difference approximation of a linear boundary value problem.

Well-known methods, both elimination and iterative, are discussed from the point of view of use in connection with modern high speed digital computing machinery. The newer methods, which include iterative procedures based on the theory of orthogonal polynomials as well as terminating iterative processes, are also considered. The important concept of the conditioning of a system of equations is introduced, and its significance is explained.

The main object of this thesis is the development of an iterative procedure with a wide range of applicability. To this end, a procedure due to Kaczmarz and Cimmino is first carefully investigated. In this method a multiple of a row of the coefficient matrix is added to the iterative at each step. It is shown that this corresponds to removal from the error vector of the projection of the error vector on a particular vector in n-space. It can be shown that the procedure will theoretically converge for any system of linear equations having a unique solution.

The error vector at the end of a cycle is expressed as the result of a matrix operating on the error vector at the beginning of the cycle. An explicit representation of this operator is obtained. It is noted that if the process is slightly changed a new iterative scheme results which corresponds to a symmetric error operator. It is then shown that the error vector approaches one direction after several cycles. This behavior makes possible an extrapolation procedure which results in an iterative method that is much faster than the original one. Convergence is further accelerated by removing projections from subspaces of dimension greater than one.

The procedure was programmed for use on ILLIAC, an electronic digital computer at the University of Illinois. A brief description is given of the method used in having the machine generate the equations in simple finite difference applications. A few test problems are reported which show that the method is satisfactory unless the equations are very badly conditioned.

58 pages. $1.00. Mic 56-1456

ENGINEERING, ELECTRICAL

ON THE FORMATION AND COLLIMATION OF AN AXIALLY-SYMMETRICAL HOLLOW ELECTRON BEAM

(Publication No. 16,355)

Leonard Caldwell Adams, Ph.D.
The University of Florida, 1956

Hollow electron beams are of considerable interest because of their application in traveling-wave oscillator and amplifier tubes. A rotating hollow beam provides a long interaction space within a relatively short axial length. Furthermore the hollow beam makes for a more efficient tube since only the outer shell of a solid beam interacts effectively with the traveling wave. The useless current in the core is eliminated.

This work presents the theory, design, and description of a tube for forming and collimating a dense hollow electron beam, along with the results of tests on an experimental model. Collimation is achieved by balancing the space charge and centrifugal forces of the electrons with an electrostatic field. Tangential motion is imparted to the beam by causing it to pass through a weak radial magnetic field.

The Pierce electron-gun technique is used for cathode region design. Qualitative and quantitative information pertinent to the design of this region is presented. Lagrange's equation is applied in the cylindrical coordinate system to derive differential equations which describe electron trajectory in the mixed electric and magnetic fields of the transition region. The resulting equations are interpreted and applied in the design of this region. Flux plotting, electrolytic tank analogue, and net-point methods for the solution of Laplace's equation are used to find the equipotential surfaces of focusing electrodes.

A description of the tube and the tube-test set-up is presented along with test results. These results confirm design predictions and show, furthermore, that the design is a practical one. 78 pages. $1.00. Mic 56-1457

AN INVESTIGATION OF HIGHER ORDER SERVO SYSTEMS WITH A NON-LINEAR COMPUTER USING PHASE SPACE TECHNIQUES

(Publication No. 16,397)

Elbert John Hagin, Ph.D.
University of Illinois, 1956

The purpose of this investigation is to study higher-order servomechanisms with the aim of improving the response by intentionally inserting a nonlinearity. The analysis is performed by means of trajectories in a transformed phase space, the coordinates of which are a linear combination of the coordinates in the error phase space. A transformed phase space is used so that the Hamiltonian equation of motion, representing the projection of the trajectory onto any of the principal planes, is a function of the coordinates in that plane alone. Thus, for any set of initial conditions in an nth-order system, the trajectory is easily studied by considering its projection on n-1 planes of the transformed phase space.

The linear amplifier of the servomechanism is replaced by a nonlinear computer, the output voltage of which is of sufficient magnitude to produce torque saturation. The sign of the voltage is determined by the computer, which is designed from a study of the phase space trajectories. A differentiating network is then added as a forward element around the computer in order that correct switching can be accomplished for any type of input, that is, step inputs of displacement, velocity, and acceleration, and for sinusoidal inputs of different frequencies.

An analog computer is used to synthesize a third-order servo system and the response to a variety of inputs is recorded. It is found that the response time is reduced by approximately 80 percent (based on the time required to reach and remain within a small value of error) and that the overshoot of error is negligible.

Because of the complexity of the computer required to produce ideal switching, an approximate switching criterion is established. A computer which is designed from the approximate criterion is then used in the analog computer synthesis. For this case, the results show an improvement of about 60 percent over the response time of a linear system with a very small overshoot of error.

For sinusoidal inputs, both the transient and steady-state response are greatly improved by using either of the nonlinear computers and the forward network.

170 pages. $2.13. Mic 56-1458

A TWO STAGE POLYPHASE ROTATING AMPLIFIER

(Publication No. 16,330)

Ahmad Kamal, Ph.D.
University of Pennsylvania, 1956

Supervisor: Cornelius N. Weygandt

The principles of a-c polyphase commutator machines are first reviewed and a two-stage machine, having two field systems with pole ratios of 1:2, is developed from these principles.

The fundamental equations are developed for steady state operation. A model is designed and the details of construction are shown.

The impedance tensor for the machine is given together with the connection tensor. It is shown that the differential equations describing the performance of the two stage electro-mechanical system are linear but with time varying parameters. A computer, however, must be used to find a point to point solution of these equations.

A quantitative comparison between the theoretical and experimental results indicates clearly the limitations and difficulties inherent in the machine.

The power gain of the two stage machine is proportional to the fourth power of speed and is independent of the sequence of the applied voltage. It is shown that the gain is limited primarily by the currents circulating in the rotor coils shorted by the brushes during the commutation period depending on the speed range.

The useful speed ranges and consequently the maximum gain are those corresponding to minimum circulating currents. It is important to note that this current cannot be completely eliminated. It can, however, be reduced by inserting high resistance connectors between the armature coils and the commutator. Since two of these connectors are always in parallel at each brush only one fourth the resistance of one connector is effectively in series with each of the output terminals of the machine. Thus, comparatively high resistance connectors, to limit the current to merely a fraction of its value, will improve the performance of the machine without any serious effect on the voltage regulation. Therefore, much higher speeds and correspondingly high gain values can be physically realized.

The machine possesses sequence sensitivity, or in other words the voltage sequence of the output follows that of the applied voltage. This property is important for control applications because it ensures the reversibility of a three-phase drive.

The frequency of the output voltage is that of the applied voltage irrespective of the operating speed. This also is an important property as far as control applications are concerned. The magnitude of the voltage and its frequency are now two independent variables.

High power amplifications can be achieved by shifting the brushes. This, however, cannot be of any practical value. They were only obtained at the expense of the reduction of the power factor at the input terminals. The full compensation of the armature reaction, under all load conditions, is established as the criterion for optimum operating condition.

The machine is inherently stable without the possibility of self excitation once the armature m.m.f. is fully neutralized and the operation is limited to the linear region. The time constant is very high because the input impedance, to each stage, is very nearly equivalent to that of a non-dissipating coil. 122 pages. $1.53. Mic 56-1459

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

AXIALLY EXCITED SURFACE WAVE ANTENNAS

(Publication No. 16,423)

Douglas Edward Royal, Ph.D.
University of Illinois, 1956

A method of exciting surface wave antennas is described. A surface wave antenna is basically an aperture in a conducting surface which is excited so that the distribution of field in the aperture consists of a traveling wave. The antenna is excited by coupling it along its direction of propagation to an adjacent waveguide through a long slot or series of holes. The adjacent waveguide carries a traveling wave having the same propagation velocity as the desired mode in the antenna.

In order to test the theory an experimental antenna was built. To observe the action of the coupling mechanism, the antenna was designed so that the rates of change of propagation velocity with frequency of the exciting waveguide and of the radiating waveguide (i.e., aperture) were large and differed considerably. In a practical application one can, on the contrary, design the antenna for broadband operation. In addition, the propagation velocities of the two guides were equal at one frequency in the range of interest. A propagation velocity very near that of free space was employed so that the antenna produced an endfire beam. This was obtained by filling the aperture of the antenna and partially filling the exciting waveguide with dielectric.

The theory employed to estimate the phase velocities in the antenna and in the exciting waveguide is shown to give results in close agreement with measured values. The aperture field of the desired hybrid mode is shown to be equivalent to an array of normal electric dipoles provided the tangential electric field in the aperture is given by $\underline{E} = \underline{\nabla} U$ where U is the scalar such that the tangential component of $\underline{E}$ at the rim vanishes (U = O). The approximate theory developed to describe the action of the coupling mechanism is shown to predict aperture distributions and radiation patterns in agreement with those obtained in practice.

The aperture distributions and radiation patterns were measured for the cases when the antenna was (a) end-fed, (b) axially excited by a long slot, and (c) axially excited by a series of holes. These measurements demonstrate that the hole array is capable of producing a pattern which is remarkably free of side lobes (spurious radiation). Patterns produced by the hole array indicate a side lobe level better than 30 db in one plane and about 20 db in the other plane as compared with a typical value of 10 db for the end-fed antenna in both planes. The purity of mode obtained with the hole array is considerably better than that obtained by feeding the antenna at one end.

104 pages. $1.30. Mic 56-1460

SYNTHESIS OF A NONLINEAR CONTROL SYSTEM

(Publication No. 16,033)

Charles Francis Taylor, Ph.D.
Stanford University, 1956

A recent mathematical nonlinear control theory* is interpreted in the light of modern control system synthesis. From this theory the process of control is visualized as establishing an ensemble of linear second order differential equations (some with stable and some with unstable homogeneous solutions) and switching from one equation to another so as to maintain small instantaneous error for relatively arbitrary inputs. Physically this control process is realized with a linear second order control system to which have been added possible discrete combinations of proportional and derivative feedback. The particular combination of feedback employed at any instant is determined by a feedback switching circuit which is in turn operated by sensed binary information obtained from the output, output derivative, error, and error derivative [namely, the signs (sgn) of these variables]. Techniques that are common to the digital computer field are used to implement this switching circuit.

Once physical realization is completed, simulation techniques are used to study and evaluate the performance of the nonlinear control system and to compare it with a linear system for a wide variety of inputs. In addition the effects of physical imperfections that are likely to be encountered in any application of the control theory are considered (e.g., switching delays and acceleration limits).

An analysis of the experimental results shows that this type of nonlinear control system performs better than a linear control system having a normalized frequency fifteen times greater. For this comparison, performance is evaluated in terms of the average value of the magnitude of the instantaneous error for band-limited inputs. Further, in contrast to the linear system, the nonlinear system performance is virtually independent of variation in the damping factor of the system.

A preliminary extension of this type of nonlinear control concept to higher order systems is presented. Experimental results are given for a third order system. These results show that just as in the second order case the nonlinear system performance is better than that of a comparable linear system.

102 pages. $1.28. Mic 56-1461

*I. Flügge-Lotz and W. S. Wunch, "On a nonlinear transfer system," Jour. of App. Phys., Vol. 26, No. 4, 484-488, April 1955.

THE ANALYSIS AND DESIGN OF LINEAR CLOSED-LOOP CONTROL SYSTEMS BY MEANS OF NUMBER SERIES

(Publication No. 16,223)

Charles Hadley Weaver, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Thomas J. Higgins

Three major objectives are attained in this thesis: the advancement of an inclusive, rigorously-based and integrated account of basic number series theory, which both includes and extends that developed hereto in numerous scattered papers of varying degrees of completeness and rigor; the formulation of a basic body of linear closed-loop control system theory couched in terms of a number series operational approach, which places this mode of analysis on a par with the Laplace transform approach;

and the illustration of the use of this theory for the analysis and design of linear closed-loop control systems by detailed numerical solution of a number of illustrative examples.

The contents of this thesis can be summarized as follows. Chapter I states the purpose of the thesis, and establishes the importance of the problem by epitomization of pertinent literature and indication of possible uses of the developed theory. Chapter II comprises account of basic number series operations. Chapter III advances a rigorous development of the theory "schematicized" in Chapter II. Chapter IV constitutes account and illustration of differentiating and integrating operators and of refinements and extensions of existing procedures. Chapter V encompasses formulation of a basic body of theory for effecting number series analysis of linear closed-loop control systems. Chapter VI entails account of number series analysis of control systems. Chapter VII advances an integrated development of system compensation and design by use of the number series techniques developed in preceding chapters. Chapter VIII comprises a summary of the major results achieved. The thesis is concluded with an appendix containing a list of standard number series operational forms and a bibliography of pertinent references.

112 pages. $1.40. Mic 56-1462

THE DESIGN AND APPLICATION OF A NONARITHMETIC DATA PROCESSING MACHINE

(Publication No. 16,438)

Joseph Marion Wier, Ph.D.
University of Illinois, 1956

Modern high speed electronic digital computers are specifically directed toward the achievement of high arithmetic computation speeds. This is accomplished by so arranging the device that those operations necessary to do arithmetic are performed by very high speed equipment. This usually requires a large amount of specialized circuitry which is not of use if the simple operations built into the circuitry are not required. Thus digital computers are well equipped to do the simple arithmetic operations such as addition, subtraction, multiplication, and division in addition to certain manipulative operations necessary to make efficient use of these capabilities. These facilities make a large class of computations rather efficient, but when the problem at hand requires other than these operations, the machines are rather clumsy and slow in operation due to the necessity of adapting the arithmetic operations to the problem. The basic computing machine which was described by Turing, and from which the modern computers evolved, is really a much more general device in concept than the computers. The instrument described in this dissertation is an extension of the Turing machine in another direction. It is designed to be used as a general transformational device which is capable of arithmetic, but which is just as conveniently able to perform transformations which are not arithmetic in nature. The price paid for this generality is that arithmetic cannot be done as efficiently as with a digital computer. It is, however, a more efficient device than a normal computer for use with those problems that are not essentially arithmetic in nature.

In order to investigate the use of machines for treating problems of the nonarithmetic class, a number of problems were tried using the Illiac, the digital computer at the University of Illinois. These problems include the following: an attempt to allow the machine to learn to play a good game of Tick Tack Toe by playing itself and recording the results, a model of an associatively addressed memory, a simple conditioned reflex learning routine, and an experiment in simulating a simple microprogrammed machine using the facilities of the Illiac. From these problems and variations on them it was decided that the following properties would be desirable in a machine used for handling nonarithmetic information: a facility for conveniently and quickly treating variable length blocks of information, a large capacity memory, a flexible order code, a random element, and a convenient way of storing and using arbitrary nonarithmetic functions.

The machine organizational design causes the device to be most useful in nonarithmetic problems. Some of the characteristics helping to meet this end may be outlined as follows:

1. It treats numbers in parallel in blocks of 2^N bits where $O \leq N \leq 5$ and N is integral.
2. It has a memory capacity of 2^{21} bits.
3. It operates internally using a microorder system of control which allows great flexibility in the order code.
4. It includes a built-in random element.
5. It provides for shuffling tables of great size and with variable entry length in a rapid and convenient way.
6. It has a number of more conventional facilities for the manipulation of the programs placed in the machine.

The problems considered for solution on the machine include those tried on the Illiac in addition to the following: a complex one-pass sorting system, a data analysis method applicable even to nonlinear data, a simple learning servomechanism model, a process for predicting the members of a nonarithmetic series, and an order code experimentation example. A number of speculations on the use of such machines for mechanizing processes not now generally done on computers are made. These speculations include the mechanization of experimentation, the performance of analytic mathematics as opposed to computational mathematics, the organization of large blocks of data under one control, and the production of adaptive devices capable of operating in a completely nonarithmetic environment. An examination of the methods of solution proposed for the machine indicates that the tabular orders within the machine are probably the most important in the treatment of these problems. Since a table contains complete information for the definition of a discrete function, these orders appear wherever it is desirable to operate with unusual functions. The variable word length feature is found to be of use where the blocks of information are not of some standard length. The random element is a convenience where any type of experimentation is performed. In general the machine is shown to be quite efficient in handling the type of problems suggested for it.

The investigation also points to a fundamentally different way of considering a data handling machine. It is shown that a device which is designed to manipulate various identifiable and distinguishable objects is not only capable of treating numbers, but is also useful for dealing with a large class of subjects in which other than numerical aspects are important.

156 pages. $1.95. Mic 56-1463

ENGINEERING, MECHANICAL

DESIGN AND DEVELOPMENT OF TRACER ATTACHMENT FOR TURRET LATHES

(Publication No. 16,138)

Ramchandra Parasharam Bang, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor James W. McNaul

In recent years, the interest shown in the development of machine tools with feedback controls, often called tracer units, has been due to their reliability, accuracy, flexibility, and unique adaptability to the machining of intricate shapes. The tracer units operate on the principle of continuous control of the cutting tool by the control mechanism actuated by a stylus or a sensing device, which follows the contour of a master template. The major problem with respect to these in the last decade has been to lower the response time of the control system so that the error would be within the tighter tolerance limits required in numerous operations.

It has been the object of this project to design and develop a tracer unit for turning operations on turret lathes, which would operate at high speed and feed rates, maintain close tolerances, and be reliable. The basic conditions for this unit are a feed rate of 0.03 inch per revolution, a depth of cut of 1/4 inch, a spindle speed of 1000 r.p.m., and a tolerance limit of $\pm$ 0.002 inch, from which the maximum allowable response time estimated is 0.002 second.

The crucial problem of obtaining almost instantaneous changes in the motion of the tool slide of this unit has required consideration mainly of three aspects: (a) inertia forces of the moving masses, (b) effect of backlash of the mating gears, and (c) time constant of the control circuit.

The design of dual magnetic clutch system reduces the effect of inertia forces, provides torque in each direction of motion of the tool slide, eliminates entirely the effect of backlash of the gears, and overcomes the inertia forces much faster. The cutting tool and the stylus are mounted on an aluminum tool slide. Two pinions connected with the driven side of the clutches are in mesh with the rack mounted rigidly on the tool slide. The driver side of the clutches is connected with the drive motor through gears.

The stylus is connected with one of the two contact points in the clutch control circuit. When the contacts are open the forward clutch is energized, and with the contacts closed, the reverse clutch is energized. Thus, one of the clutches is engaged all the time. While the tool slide moves forward the stylus comes in contact with the master template; at the instant it is deflected by an amount equal to the actuating error, the contacts close and the tool slide moves in reverse, which opens the contacts and it moves forward again. The resultant error of this oscillatory movement depends upon the response time of the control circuit.

The longitudinal feed of the tool slide is obtained from the tool post carriage. The motion of the cutting tool relative to the workpiece is the resultant of the above two.

With the above 'on-off' type control, the time constant of the clutch circuit has been found to be too long because of the high inductance of the magnetic clutches. In order to decrease the response time, a continuous control dual clutch electronic feedback circuit is recommended and fully discussed. In this circuit, the clutches are energized in mutually inverse proportion. When the stylus is in neutral position, both clutches are partially energized to equal extent and are slipping. The stylus deflections from its neutral position actuate the circuit such that the proper clutch energizes fully while the other de-energizes. Thus, the tool slide moves to the desired position.

The mechanical assembly of the tracer was completed, but the feedback control circuit had not been designed. Several test runs, conducted to determine the mechanical efficacy only, indicated that the tracer performance was satisfactory. As no data could be obtained for the response time without the associated control circuit, no attempt was made to record any observations during these tests. Further developmental work required has been indicated at the end. 195 pages. $2.44. Mic 56-1464

AN INVESTIGATION OF THE INTERMITTENT MOTION OF CERTAIN BODIES SLIDING ON ICE

(Publication No. 15,975)

Coleman Dudley Fitz, Ph.D.
University of Minnesota, 1954

The theoretical motion of a sliding block drawn over a stationary plane by a flexible member attached to a moving frame was analysed for certain assumed friction functions. It was shown that for a certain range of the parameter constants of the assumed friction functions the resulting motion of the slider is an oscillatory motion made up of sudden forward jerks followed by periods of rest. For other values of the constants the slider motion may become continuous. The critical conditions of the friction parameters separating the intermittent from the continuous motion were determined.

The technical literature regarding previous work on friction generated oscillations was examined. The classical laws of friction were discussed and the current theories regarding mechanical friction were presented. Facts and theories regarding the low frictional resistance of materials on ice were also discussed.

A method of determining the constants of the assumed friction functions from the experimental position-time traces of sliders drawn over a stationary base was presented.

A frictional force measuring apparatus which had been constructed for the determination of the friction force between materials at moderately low temperatures was described. The application of this apparatus to the experimental examination of the actual motion of certain sliders drawn over an ice sheet was also described. From the experimental observations of the motion of certain bodies drawn by a flexible arm over an ice sheet the following conclusions were drawn:

1. The oscillatory motion observed compares very closely with the theoretical motion of a sliding body resisted by a high static friction and a lower constant kinetic or Coulomb friction.
2. In the case of magnesium on ice, where the kinetic friction is affected by velocity, the damping constant is negative.
3. A continuous type of sliding motion was not detected within the range of experimental parameters tested.

4. There is a decrease in static and kinetic friction between most materials and ice with an increase in temperature from -45°F. and -30°F. to + 15°F. Hickory, however, indicated an increase in friction with an increase in temperature from -30°F. to + 15°F.

5. There is a decrease in the static friction of materials on ice with a decrease in the time of stationary contact.

6. Magnesium and hickory had the highest static friction and the greatest difference between static and kinetic friction of the five materials tested.

7. Brass had the lowest kinetic resistance followed in order by plastic, steel, hickory and magnesium.

8. The liquidlike film on the surface of ice does not act as a viscous substance under the contact region of the studied bodies. 292 pages. $3.65. Mic 56-1465

THE MECHANICS OF FILM FLOW ON A VERTICAL SURFACE

(Publication No. 16,466)

Arthur Bernard Greenberg, Ph.D.
Purdue University, 1956

Major Professor: Dr. Maurice J. Zucrow

An investigation was conducted of the flow of liquid films down the inside surface of a vertical tube. The thickness of the films, the velocities of the waves appearing on the surface of such films, and the profiles of those waves were studied as functions of the physical properties of the flowing liquid; these studies were made over a range of Reynolds numbers varying from 3 to 1640. The film thicknesses and the wave profiles were measured by means of a sensitive photometric technique which could detect changes in film thickness as small as 40 microinches.

The results of the investigation indicated that the measured values of film thickness for a liquid film flowing down a vertical wall were smaller than the values calculated by the following equation, due to Nusselt. Thus

$$t = \left(\frac{3\, G' \mu}{\gamma^2} \right)^{1/3}$$

The discrepancy between the measured and the calculated values of film thickness was found to be related to the nature of the wave motion on the surface of the film, the physical properties of the liquid, and the Reynolds number of the flow. In general, at Reynolds numbers less than approximately 35 the discrepancy varied from zero to 20 per cent, whereas at higher Reynolds numbers the discrepancy was from 10 to 35 per cent.

Three types of wave motion were found to occur on the surface of a liquid film; (1) ripples, (2) "regular" waves, and (3) "random" waves. The velocities, the amplitudes, and the frequencies of the ripples and the "regular" waves were measured over the entire range of flow conditions investigated.

A theoretical analysis is presented of the flow of a liquid film with "regular" waves moving on the film surface.

244 pages. $3.05. Mic 56-1466

AN INVESTIGATION FOR THE MECHANISM CAUSING ELECTRICAL POWER-TRANSMISSION LINES TO GALLOP

(Publication No. 16,470)

John Louis Hartman, Ph.D.
Purdue University, 1956

Major Professor: R. C. Binder

The problem of this thesis was to get definite information which would help explain the mechanism causing electric power-transmission lines to exhibit low-frequency, high-amplitude induced vibrations known as galloping.

The thesis was divided into two major phases. The first phase was the coordination of vortex shedding phenomenon, particularly behind cylindrical and D-section bodies. The second phase was an investigation of an ice-coated transmission line's torsional motion as related to galloping.

The first phase was sub-divided into five sections. Section A was focused upon the literature pertaining to vortex shedding behind stationary cylinders. Results of two recent investigations of vortex shedding behind stationary cylinders are presented in detail. Numerous experimental results were found in the literature and are presented in this thesis in tabular form. An analysis was made on the tabulated data to determine its completeness and reliability.

Section B was directed towards the experimental investigation of vortex shedding phenomenon behind stationary cylindrical, D-section, ϑ-section, and 8-section models. This experimental investigation was conducted by means of a towing-tank apparatus. The various models were pulled through static water and the resulting vortex shedding phenomenon was recorded. The experimental results of vortex shedding behind cylindrical models are presented in this thesis as a means of evaluating the reliability of the experimental technique employed to obtain vortex shedding data. The vortex shedding data from the D-section, ϑ-section, 8-section models are presented as new information.

Section C was focused upon reviewing the existing literature pertaining to vortex shedding behind non-stationary bodies, mostly cylinders. Interesting results were obtained from this phase of the literature that revealed the importance of the body's motion upon the vortex shedding phenomenon.

Section D was directed on an experimental investigation of vortex shedding behind non-stationary bodies. Results of this section revealed that torsionally mounted modified cylindrical and D-section models under certain flow conditions were induced to torsionally oscillate and exhibited a definite control over the vortex shedding phenomenon. For a wide range of flow conditions, the vortex shedding frequency behind these torsionally oscillating models was found to be independent of the approaching air velocity value.

Section E was directed upon explaining the significance of the results of Sections A, B, C, and D as related to galloping transmission lines. This section revealed that when a transmission line was at rest, there exist only a few critical values of wind velocities that will produce a vortex shedding phenomenon which has a tendency to promote galloping. Although if the line receives, by some means, a

torsional oscillating motion; then there will exist a vortex shedding phenomenon which has a tendency to promote galloping when the line is subjected to a large range of wind velocities.

The second phase was sub-divided into three sections. Section 1 was an investigation of galloping by means of a transmission-line model study. The work of this investigation was conducted in a wind tunnel under controlled conditions.

Section 2 was a theoretical, life-drag study of the galloping motion exhibited by the transmission-line model to determine what features were important in promoting galloping.

Section 3 was the application of the findings of Section 1 and Section 2 to an experimental transmission line.

The results of these sections revealed the importance of the torsional motion of an ice-coated transmission line, which was geometrically similar to a D-section, as related to the tendency for the line to gallop.

Analysis of the results of the various investigations conducted in this thesis indicated that the mechanism causing an ice-coated transmission line with the physical characteristics of an unsymmetrical D-section and equivalent natural torsional and vertical frequencies to gallop was a combination of a vortex shedding phenomenon and a lift-drag phenomenon. 186 pages. $2.33. Mic 56-1467

ANALYTICAL STUDY OF HEAT TRANSFER IN LIQUID METALS

(Publication No. 16,478)

Paul S. Lykoudis, Ph.D.
Purdue University, 1956

Major Professor: Yeram S. Touloukian

The problem of heat transfer to liquid metals is studied for the case of a fully developed turbulent flow in cylindrical pipes of constant diameter, the fluid under consideration being heated (or cooled) by a constant and uniform heat input at the wall. Constant thermophysical properties are assumed.

In the analysis of temperature profiles and heat-transfer coefficients the similarity theory between heat and momentum transfer is used.

Based on the mixing length concept, a modified theory is presented which gives the ratio of eddy diffusivities, σ, for heat and momentum transfer as a function of the Prandtl modulus.

It is shown that in the case of the liquid metals ($N_{Pr} < 0.1$) the dimensionless temperature ratio $T = (t_w - t)/(t_w - t_c)$, and the Nusselt number depend only slightly on the velocity profile. On the basis of this fact an approximate continuous universal velocity profile is used in the analysis.

It is shown that heat transfer in liquid metals can be analysed universally in terms of a dimensionless parameter called the "Generalized Peclet Modulus," and defined by the relation

$$N^*_{Pe} = (N^*_{Re})\,(N^*_{Pr}) = (N_{Re}\sqrt{f/2})\,(N_{Pr}/\sigma)$$

where f is the Fanning friction factor.

It is proved that for liquid metals the dimensionless temperature ratio T is only a function of the distance from the wall and the generalized Peclet modulus; limited available experimental data give good support to the theoretical predictions. It is furthermore proved that for $N_{Pr} = 0$ the limiting temperature profile is a parabolic one.

It is shown that the dimensionless mixing cup temperature $\theta = (t_w - t_{mc})/(t_w - t_c)$ is a strong function of the generalized Peclet modulus and a weak one of the Reynolds modulus. A limiting expression is derived indicating that for $N_{Pr} = 0$, the ratio θ is a weak function of the generalized Reynolds modulus; it is further shown that for $N_{Pr} = 0$ and $N_{Re} = \infty$, θ assumes assymptotically the minimum value of 0.5.

It is shown that for liquid metals the Nusselt modulus is a strong function of the generalized Peclet modulus. An analytic expression is derived which gives the Nusselt number as a continuous function of the generalized Reynolds number for $N_{Pr} = 0$; this expression gives the value 8 for $N_{Re} = \infty$ as found also by Lyon, and the value 6.8 for $N_{Re} = 2000$. The extensive experimental data on heat-transfer coefficients for liquid metals are shown to correlate satisfactorily when plotted in N_{Nu} vs N^*_{Pe} coordinates.

Based on the exact equations derived in the text the following approximate relations are offered as sufficiently accurate expressions for most engineering calculations:

$$\lim_{N_{Pr}\to 0} N_{Nu} \approx 4\left\{\frac{21n\,(N^*_{Re}) - 4.39}{1n\,(N^*_{Re}) - 1.61}\right\}$$

For $N^*_{Pe} \leq 10^4$: $N_{Nu} = 7 + 0.30\,(N^*_{Pe})^{0.8}$

For $N^*_{Pe} > 10^4$: $N_{Nu} = 0.12\,(N^*_{Pe})^{0.9}$

For $N_{Pr} \leq 0.1$: $\sigma \approx 0.61\,(e^{-0.01/N_{Pr}} + 0.25e^{-0.04/N_{Pr}})$

The work contains rather extensive tabulations of the quantities T, θ, and N_{Nu}, and also a nomogram for rapid calculation of the Nusselt number in terms of the Prandtl and Reynolds numbers.

200 pages. $2.50. Mic 56-1468

AN INVESTIGATION OF TRANSIENT TOOL FORCES AND TEMPERATURES IN PLAIN PERIPHERAL MILLING

(Publication No. 16,413)

Dean Earl McFeron, Ph.D.
University of Illinois, 1956

Instrumentation is described for the determination of the instantaneous variation in forces and average tool-chip interface temperatures under near-commercial cutting conditions for a carbide tool and a steel workpiece. In addition, supplementary techniques have been evolved for the measurement of associated quantities required in the calculation of the interface temperature.

Equations and a calculation procedure necessary for the evaluation of the instantaneous, average tool-chip interface temperature are also presented. Use is made of

Jaeger's analysis for the temperature developed by a moving band source of heat and of Blok's partition principle for the division of heat between sliding contacts. The heat source on the tool top surface is treated as a variable strength source acting over a variable contact area as obtained in milling. Good agreement is obtained between calculated and measured values of the instantaneous, average tool-chip interface temperature.

By means of the equations developed, the influence of changes in the cutting conditions can be predicted without extensive experimentation. The effect of limited changes in the workpiece or tool temperatures on the interface temperature is discussed. Similarly, the effect of a change in the specific heat of the tool material is presented.

100 pages. $1.25. Mic 56-1469

EXPERIMENTAL INVESTIGATION OF THE HEAT TRANSFER BY FORCED CONVECTION FROM THE HOT GAS TO A COOLED RADIAL FLOW TURBINE ROTOR

(Publication No. 16,491)

Richard Dunham Smith, Ph.D.
Purdue University, 1956

Major Professor: M. J. Zucrow

An investigation of forced convective heat transfer in the turbulent regime from the hot gases to a cooled radial flow turbine rotor, made from aluminum, was conducted on a 12.2 inch diameter radial flow gas turbine. The turbine was operated at pressure ratios of 1.8 and 2.4, tip speeds of 854 ft/sec and 964 ft/sec, turbine inlet temperatures of 500 F, 550 F, and 600 F, and isentropic velocity ratios of 0.57 to 0.68. The turbine rotor was cooled by a flow of cooling air over the back shroud of the rotor.

The flow of a gas through a radial flow gas turbine is discussed; in particular, the character of the flow in the turbine rotor passages. The equations for the ideal one-dimensional flow of a gas in a rotating passage are also presented.

The heat transfer coefficients were calculated from the experimental data with the aid of a thermal analyzer, which employs the analogy between the flow of heat and the flow of electricity.

The local heat transfer coefficients in the passages of the turbine rotor were correlated by the equation which was derived for the forced-convective heat transfer from a flat plate in turbulent flow. The physical property terms in the Nusselt, Prandtl, and Reynolds numbers are evaluated at the bulk gas temperatures, the linear dimension employed in the Nusselt and Reynolds numbers is the distance from the inlet of the rotor to the point of calculation, and the velocity in the Reynolds number is the average velocity of the gases (at a given radius in the passage) relative to the rotor passage.

264 pages. $3.30. Mic 56-1470

ENGINEERING MECHANICS

EFFECT OF CHANGE IN THE CYCLIC SECANT MODULUS ON THE BENDING STRESS DISTRIBUTION AND FATIGUE STRENGTH OF VARIOUS CROSS SECTIONS

(Publication No. 15,917)

Allan A. Blatherwick, Ph.D.
University of Minnesota, 1955

The influence of changing cyclic properties during the course of fatigue tests on the stress distribution and the resulting fatigue strength is examined.

In the first phase of the work, a hypothetical analysis is made from assumed material properties. A stress-strain relationship is assumed consisting of an elastic line of constant slope and a plastic line whose slope varies with cycles of repeated stress. Two material types are considered. In one case (strain-hardening type) the slope of the plastic line increases with number of stress cycles, while in the other case (strain-softening type) the slope decreases.

Five cross-sectional shapes are considered, ranging from one having the bulk of its area near the center to one having the greatest area remote from the center. From the family of assumed stress-strain curves (each curve valid for a given number of cycles), a corresponding family of moment-strain curves is calculated for each cross-sectional shape. These sets of curves, together with the assumed stress-strain curves, provide the information for analyzing the behavior of stress, strain, and bending moment during given fatigue test conditions.

Three types of bending fatigue test conditions are considered. In one, the strain in the outer fibers is held constant and the variation of stress and bending moment is calculated. In the second type the maximum stress is constant and the strain and moment variations are computed. The third type is a constant-moment condition in which the stress and strain behavior is analyzed.

On the basis of these analyses, comparisons are made between the results to be expected from the three types of tests for the two kinds of material. The influence of cross-sectional shape of specimen on fatigue life is examined.

In the second phase of the work, an experimental investigation is conducted on the effect of changing cyclic secant modulus on the bending fatigue strength. Using the stress-strain properties determined by axial-stress tests of normalized SAE 1020 steel and of 2024-T4 extruded aluminum alloy, the variations of stress, strain, and bending moment to be expected during the three types of bending fatigue tests are computed. These predicted variations are verified by actual fatigue tests on solid and hollow specimens, and the usual fatigue data are obtained.

To supplement the fatigue data, the rates of growth of fatigue cracks were observed. These crack-growth data aid in distinguishing the effects of the various test conditions coupled with the variation of the cyclic modulus.

The results of the tests are compared with the predicted behavior from the hypothetical analysis and with the results of prior work.

245 pages. $3.06. Mic 56-1471

UNIFORMLY LOADED SQUARE PLATE WITH NO LATERAL OR TANGENTIAL EDGE DISPLACEMENTS

(Publication No. 16,429)

Floyd James Stanek, Ph.D.
University of Illinois, 1956

The theory of large deflections of plates involves two non-linear differential equations, the solution to which is unknown for the general case. Therefore, various approximate methods are used. The method of finite differences and the Ritz energy method are two of the common approximate methods which have been used by various authors.

The purpose of this thesis is to obtain an analysis of a uniformly loaded square plate with no lateral or tangential displacements along the edges. It is assumed that these boundary conditions placed upon the displacements will be representative of the bottom of a bin or box which is supported by corner legs, such as a gravel bin.

The Ritz energy method is used. The expressions for the displacements, w, u and v, are assumed to be in the form of double trigonometric series. Three complete solutions were made, each time increasing the number of terms in the series, for various values of the dimensionless load (qa^4/Dh) up to approximately 100,000. The results of the various solutions are then compared.

The following is given in the results:

1. Table of values of the unknown parameters which appeared in the assumed expressions for w, u and v.
2. Figure showing the maximum lateral deflection of the plate by all three solutions.
3. Figure showing the comparison of the maximum lateral deflection of the plate with that obtained from the work of previous authors; namely, a plate simply supported along the edges and a plate clamped along the edges.
4. Figures showing the maximum principal stresses along the diagonal and the edge of the plate.
5. Figure showing the maximum principal stresses at a point on the edge of the plate by all three solutions.

It is felt that there is good convergence indicated in the comparison of results of the three solutions, for both the stresses and the displacements. The results agree reasonably with those of previous authors.

32 pages. $1.00. Mic 56-1472

EFFECTS OF AREA LOADING ON ISOTROPIC CYLINDRICAL SHELLS

(Publication No. 12,372)

Angel Piccio Villasor, Jr., Ph.D.
Cornell University, 1955

When the circular cylindrical shell is subjected to radial pressure, its compatibility equation as expressed explicitly in terms of the radial deflection may invariably be put in the following exact form:

$$\nabla^8\omega + \frac{12(1-\nu^2)}{h^2\ r^2}\omega_{4x} + (F) = \frac{\nabla^4 q}{D} \qquad (A1)$$

In the classical derivation, the term (F) is generally a first degree polynomial consisting of lower order partial derivatives of ω; its specific constituency depends on the relative approximations made and varies to some extent. By suppressing all the other terms, Eq. A1 may be simplified to the form:

$$\omega_{8S} + \frac{12(1-\nu^2)}{h^2\ r^2}\omega_{4x} = \frac{\Psi(q)}{D} \qquad (A2)$$

This approximation is similar to Schorer's Theory, though it does not neglect some forces and moments in its fundamental assumptions. Eq. A2 may properly be called the "Modified Schorer's Theory".

Computations show that the roots of the characteristic equations arising from Eqs. A1 and A2 differ by a small percentage when the shell is long and flexible. This difference, however, increases when the shell is short. When the complementary solution of Eq. A1 is put as the sum of two damped waves, the principal effect of Eq. A2 is merely a modification of the damping rate of the component waves. In using Eq. A2, corrections may have to be applied, especially for short and stiff shells, but a distinct advantage is gained in extensive computations. For a single concentrated load, Eq. A2 results in lower radial deflection values in long shells but higher in short cylinders. The flexibility parameter is denoted by "m". A comparison of some deflection values computed for the concentrated load indicates that Eq. A2 holds with practical accuracy when $m > 4$. When $m < 4$, a graphical process of obtaining a corrected "m" is suggested. This procedure gives deflection values that closely check with Roark's measurements despite the fact that his cylinders had their ends unsupported and open.

In the consideration of area loading, the double Fourier series solution of the compatibility equation, while conveniently adaptable to rectangular loading, becomes beset with difficulties when applied to circular loading. The general method of integrating elementary line loads over an area is aptly resorted to for both cases. When the load is simple, uniform, and transversely-applied, it may be considered as a series of line loads, parallel to the generatrix with lengths depending on the area. Each line load may then be resolved into its radial and tangential components.

Eq. A2 is applied to an elastically isotropic, homogeneous shell that is simply-supported at its ends. To take each load component into account, the coefficients of the complementary function are determined from the boundary conditions. After shifting the ø-coordinate in the two component expressions of the radial deflection, each is integrated properly for the area. Their algebraic sum gives the total deflection. To obtain the circumferential moment formulas, the same process was followed.

Computations were made for 150 cases of circular loading in the following parameter ranges: Load circle size (r^1/r), 0.001 - 0.10; Shell thickness (r/h), 50 - 2000; and Shell length (r/l), 0.05 - 2.00. Some effects of the shell loading over a circular area, as observed from the plotted graphs, are enumerated without regard to the basic error due to the approximation in Eq. A2:

1. For small loading circles, the radial deflection is directly proportional to "m". When the shell is more flexible but short, the enlargement of the circle causes the deflection to fall below "Schorer's Curve", which is the deflection variation for a single concentrated load. For a given "m" and size of the load circle, the deviation

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increases with the shorter shells. This change is aggravated with the correction of the fundamental error of Eq. A2.

2. The radial deflection varies logarithmically with r/h when the load circle is small. This is similar to the behavior induced by one concentrated load and holds true even for the bigger loading circles when the shell is long. In general, the radial deflection varies inversely as the nine-fourths power of the shell thickness, although for the shorter shells, the deflection decreases far more rapidly with the dilation of the loading circle.

3. The radial deflection generally varies directly with the square root of the shell length.

4. As the load circle grows bigger, the radial deflection decreases for the same total load. It decreases sharply when $r^1/r>0.10$, especially for the shorter and thinner shells. The contribution of the tangential component of the load can no longer be neglected when $r^1/r>0.10$.

5. Under the action of a single concentrated load, the maximum circumferential moment tends to infinity.

6. In logarithmic coordinates, M_ϕ varies with the shell thickness along curves having negative slopes. If the loading area is small or the shell is long, the slopes are constant but they increase when the shell is shorter and the load circle bigger.

7. For each loading circle, the M_ϕ curve starts at some low value when the shell is long. This value increases gradually as the shell shortens but rapidly as the shell becomes very short. When $r^1/r \geqslant 0.05$ and $r/h \geqslant 300$, the moment values drop off suddenly as the shell becomes very short. This phenomenon depends also on the shell thickness and is probably related to the rapid increase in the shell rigidity as it shortens. The effect of the fundamental error has to be considered, too.

8. The circumferential moment decreases with the enlargement of the load circle for a given total load. The contribution of the radial component of the load tapers off very quickly when $r^1/r>0.05$ for the short and thick shells. Then the tangential component seemingly becomes the more influential.

A comparison with Prof. Bijlaard's equivalent values within the limits of the computation ranges shows a discrepancy of about 4 or 5% for the radial deflection and about 2 or 3% for the moment in the circumferential direction. 95 pages. $1.19. Mic 56-1473

ENGINEERING, METALLURGY

THE ROLE OF STRONTIUM ADDITION AGENTS IN THE ELECTROLYSIS OF ZINC SULFATE ELECTROLYTES

(Publication No. 16,455)

Neill J. Carson, Jr., Ph.D.
Purdue University, 1956

Major Professor: Thomas J. Hughel

The influence of strontium additions to an electrolytic zinc cell on the lead content of the cathode deposit was studied using radioactive lead. The first work undertaken was a series of tracer experiments which were designed to find sources of lead within the cell. These experiments consisted of substituting lead containing radioactive lead for the stable lead within the cell and operating the cell for 24 hours. At the end of this period the cathode deposit was stripped from the cathode and analyzed for lead using a Geiger counter. These experiments showed that the only significant sources of contaminating lead within the cell were the anodes.

After the source of lead was determined, all subsequent experiments were performed using anodes made from lead containing radioactive lead. No other lead came in contact with the electrolyte during these experiments. Runs were made with and without addition agents and the lead contents of the cathode deposit, the electrolyte, and the cell mud were measured following each run. In all cases the major part of the lead leaving the source went into the mud. Strontium, added to the electrolyte in the form of carbonate, oxide, or sulfate, decreased the amount of lead depositing with the zinc. The most important fact observed was that the strontium additions decreased the amount of lead leaving the anodes. Partial runs were also made and curves showing the variation of total lead content of the cathode deposit with time were plotted for plain runs and runs to which strontium carbonate had been added.

A similarity was noticed between the conditions existing in an electrolytic zinc cell and those existing in a lead-acid storage battery. Since conditions near the lead surface are the same in both situations and strontium sulfate is also added to storage batteries, it is logical to suspect that the role played by the strontium compound is similar in both situations. This would mean that strontium sulfate furnishes nucleation centers for the precipitation of lead sulfate.

To account for the experimental results, it is proposed that lead dissolves in the electrolyte, under the influence of the applied voltage, to a degree that results in the electrolyte near the anodes becoming supersaturated with lead sulfate. The precipitation of this lead sulfate back onto the anode surface is aided greatly by the presence of crystalline strontium sulfate on the anode surface. The presence of strontium on the anode surface was verified by x-ray fluorescence.

The strontium sulfate is thought to be precipitated on the anode surface by a high concentration of sulfate ions in the immediate vicinity of the anode surface.

To substantiate this proposed mechanism of heterogeneous nucleation, barium carbonate was added to the electrolyte. Barium sulfate is similar in crystal structure to lead sulfate and should have produced similar results. This was verified by experiment.

85 pages. $1.06. Mic 56-1474

SOLUBILITY OF NITROGEN IN LIQUID IRON AND IRON ALLOYS

(Publication No. 16,474)

Vikash Chander Kashyap, Ph.D.
Purdue University, 1956

Major Professor: N. A. D. Parlee

Solubility measurements of nitrogen in liquid iron and iron alloys were made using a refined type of Sieverts' apparatus. Argon was used to determine the "hot volume".

Binary systems studied were iron-nickel, iron-molybdenum and iron-vanadium. The alloy concentrations varied from 1 to 20 percent for nickel and from 1 to 10 percent for both vanadium and molybdenum. The ternary systems contained 1, 2 and 3 percent vanadium and 1, 3 and 5 percent molybdenum.

The results show that the solubility of nitrogen in liquid iron follows Sieverts' law over the range 50 mm. to 750 mm. pressure. The solubility of nitrogen in iron at 1600°C and 750 mm. pressure was found to be 33.9 c.c. (S.T.P.) per 100 grams of iron (0.043%). The solubility increased slightly with the increase of temperature.

The solubility determinations in binary and ternary systems were made at 750 mm. pressure only. An addition of 20% nickel decreased the solubility of nitrogen in 100 grams of iron from 35.0 (0.044%) to 23.8 c.c. (0.030%) at 1700°C. At constant pressure the solubility of nitrogen in binary alloys containing more than 2% nickel was found to be independent of the temperature. Molybdenum additions increased the solubility of nitrogen in liquid iron. At 1700°C the increase per 100 grams of alloy was 0.94 c.c. (0.001%) per percent of molybdenum added. For melts containing more than 3% molybdenum the solubility was independent of the temperature. Vanadium increased the solubility of nitrogen in liquid iron. Up to 3% vanadium the increase was directly proportional to vanadium content and had a value of (0.089%) 69.5 c.c. per 100 grams of alloy. At 10% vanadium the value reached (0.326%) 256 c.c. per 100 grams of alloy. The solubility decreased with increase of temperature.

Values of the logarithms of the activity coefficients of nitrogen in binary systems, when plotted against percent alloying elements, fell approximately on straight lines. Solubility data on binary systems iron-vanadium and iron-molybdenum were used to predict the solubility of nitrogen in the ternary system iron-molybdenum-vanadium using the method suggested by Wagner and Chipman. Solubilities calculated by this method were shown to be in approximate agreement with the experimentally determined values.

107 pages. $1.34. Mic 56-1475

THE EFFECT OF ULTRASONIC ENERGY ON AUSTENITE DECOMPOSITION

(Publication No. 16,483)

James Graham Morris, Ph.D.
Purdue University, 1956

Major Professor: Dillon Evers

The effects of ultrasonic energy on austenite decomposition were investigated in this study.

Initial investigational experiments indicated that the microstructure of steels was altered when the steels were subjected to ultrasonic energy while cooling these steels from the austenitic state. Subsequent Jominy End Quench Tests indicated an increased hardenability for those steels being irradiated with ultrasonic energy.

Isothermal transformation analysis studies indicated that the rate of transformation was decreased for those steels bombarded with ultrasonic energy. The effect of this decreased rate was not exhibited to the same degree at all isothermal transformation temperatures, being negligible at bainite formation temperatures but quite significant at pearlite transformation temperatures. Nucleation and growth rate studies showed that this decreased rate of transformation was to be explained by a decreased growth rate produced in the steel by the ultrasonic waves.

Conventional metallographic photomicrographs and electron photomicrographs indicated visually the same results as were determined analytically.

127 pages. $1.59. Mic 56-1476

ENGINEERING, SANITARY AND MUNICIPAL

THE MECHANISM OF OXYGEN TRANSFER THROUGH A COMPOST MATERIAL

(Publication No. 16,226)

Billy Joe Shell, Ph.D.
Michigan State University, 1955

An investigation was made of the single physical phenomenon of compost aeration. Investigation of the literature was made to determine methods used in the past to characterize aeration in porous mediums. Compost conditions more nearly approximate soil conditions than any other mediums recorded in the literature.

All previous work on soil studies credit diffusion as being the process most responsible for soil aeration.

The possibility of measuring oxygen diffusion through compost material with buried chambers was attempted with little success. A new method was developed whereby simple apparatus could be utilized to determine diffusion rates of oxygen through the compost material. This method was entirely for the laboratory, but it served to correlate aeration with moisture contents and depths of materials.

Evidence has been presented to indicate that diffusion alone cannot supply enough oxygen to maintain an active aerobic composting process.

105 pages. $1.31. Mic 56-1477

A HISTORY OF CHURCH ARCHITECTURE IN NEW FRANCE (VOLUME I TEXT AND VOLUME II PLATES)

(Publication No. 10,910)

Alan Wilbert Gowans, Ph.D.
Princeton University, 1950

This thesis is a study of the evolution of the distinctive stylistic character of the church architecture of New France, as the Province of Québec was known while it was a French colony, i.e., during the period from the foundation of the colony to its Cession to Great Britain in 1763. There is not much extant evidence as to the form of these buildings, but documentary evidence is fairly abundant. The thesis is therefore fundamentally a problem of reconstruction. Besides source material, there are a great number of studies relevant to this subject, most of them representing parish histories or archival researches on single monuments, and, unfortunately, interwoven in many cases with much fanciful antiquarian romancing. The first problem is to separate fact from fancy in this source material, and to relate the facts so as to make a comprehensible and coherent stylistic analysis.

By means of a catalogue raisonné appended to the thesis, I have attempted to present in orderly chronology the documentary evidence involved, reserving for the text the main thread of the stylistic evolution deducible from these facts as set in the general cultural environment of the period.

A second problem is to trace the European origins of the church architecture of New France. It has seemed to me that there are four main categories to be detected in the church architecture of New France. Of these, the first three-- viz., mission chapels, devotional chapels, and parish churches-- in my opinion drew upon the traditions of folk craftsmanship prevalent in seventeenth-century France. The fourth category, represented by the church architecture erected by the religious Orders working in New France, could draw upon outside resources for support, and was based, I believe, upon the more up-to-date and "academic" trends of the period in France. The architectural styles favoured by the Jesuits and Sulpicians probably were inspired by Jesuit and Sulpician architecture in the Paris region, and represented the most advanced architecture in the colony. This is true to a limited extent of the architecture of the Récollet Order; however, being a branch of the Franciscans, the Récollets also display a predilection for reminiscences of the mediaeval architectural forms prevalent at the time of their founding, a tendency strong in the craft tradition. As a sort of bridge between the more advanced "academic" trend and the more retardataire craft tradition in the colony, the Récollets play an important role during the eighteenth century in New France. In this period, a growing spirit of independence and self-sufficiency in New France was manifested in a trend towards synthesis of the various elements in the church architecture of New France, pointing towards the creation of a mature indigenous architectural style. This movement was on the way to full realization by the middle of the century. However, it was abruptly choked off by the Seven Years' War and the Cession. New France ceased to exist in 1763, but not before a secure foundation for nineteenth-century developments in Québec had been laid. In the history of the church architecture of New France, we can trace the manifestation, in perhaps its most clearly demonstrable form, of a tenacious culture which still forms part of the living heritage of North America today.

454 pages. $5.68. Mic 56-1478

ANALYSIS OF VANILLA AND RELATED FLAVORING MATERIALS

(Publication No. 16,439)

Louis Albert Wollermann, Ph.D.
University of Illinois, 1956

Studies were made on two procedures for estimating vanillin and some related compounds in vanilla extracts.

In the Folin-Denis method it was found that upon lowering the concentration of the sodium carbonate reagent to 10% or else adding 5 ml of a 10% solution of sodium hexametaphosphate just prior to the addition of the phosphotungstic-phosphomolybdic acid reagents, no precipitation occurred when the blue color developed. The modification was applied to the estimation of vanillin and to vanitrope (propenyl guaethol). Levulose and vanillic acid interfere.

In the ultraviolet absorption method it was found that pH control is essential in the determination of vanillin. A pH of 5.1 or lower or else 9.7 or greater is required to get maximum absorption. The pK value of vanillin was found to be 7.4. Procedures were devised for the analysis of mixtures of vanillin and vanitrope using ultraviolet absorption in both acidic and basic solutions.

Both sodium hexametaphosphate and sodium tripolyphosphate were found to complex the excess lead (from the lead acetate clarification reagent) in alkaline solution. The polyphosphate is preferred since it was found to be effective

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up to pH 10.8 where as metaphosphate was only effective up to pH 9.8. A pH of 10.5 is recommended for determination of vanillin.

Studies on the lead defecation operation indicated that about 10% of the vanillin is lost from solution. Also removing the excess lead by precipitation causes additional loss. 99 pages. $1.24. Mic 56-1479

FACTORS AFFECTING THE RATE OF CHICKEN MEAT DEHYDRATION UNDER VACUUM

(Publication No. 15,292)

Ka Teng Yao, Ph.D.
University of Illinois, 1955

A study was made of the factors that affect the drying rate of chicken meat under vacuum. The factors included the drying temperature, drying pressure, refreezing, precooking, initial moisture content, muscle thickness, heat transfer, and type of muscle.

The equipment used consisted of a vacuum drier, a condenser, vacuum pumps, refrigeration and heating systems, and instruments for temperature measurements. Both precooked and raw breast, thigh, and leg muscles were employed as the raw materials. All muscles had been defatted and deboned. Muscle size was approximately $1\frac{1}{2}$" x 2" x 5/8".

Prior to the investigations of the factors that affect the drying rate, a series of experiments were conducted in order to set up approximate drying conditions which would serve as a guide for the study of the various drying factors. The results of the experiments indicated that the drying pressure should be maintained below 1 mm Hg., the sample should be refrozen at 0°F or lower before drying, a drying time of at least 7 hours should be used, and the drying temperature should be lower than 145°F.

After completion of the preliminary experiments, the investigation on the drying factors was undertaken. It was found that the higher the drying temperature the faster would be the rate of drying. However, if drying was carried out above 145°F the product color turned dark. The drying rate was increased when the pressure was lowered from 20 mm Hg. to 0.2 mm Hg. It was also found that the sample should be refrozen before drying in order to avoid case hardening and obtain a high drying rate. The drying rate could be accelerated by increasing the transfer of heat by conduction from the heated shelves to the product.

It was evident that the thicker the sample the slower was the rate of drying. No significant differences were found in the drying rate by variations in the initial moisture content, type of muscle and precooking.

Organoleptic tests and rehydration ratios were included in this study to evaluate the effect of the drying conditions on the finished product quality. It was found that there were no apparent differences in color, flavor, and texture of the precooked products dehydrated at temperature of 20°F to 130°F. The texture of the raw sample was generally poorer than that of the precooked samples. The rehydration data indicated that the water reabsorbed by the dehydrated product varied from approximately 48 to 89 percent of the water lost during drying.

76 pages. $1.00. Mic 56-1480

ALIGARH, U. P., INDIA: A GEOGRAPHIC STUDY OF URBAN GROWTH

(Publication No. 15,053)

Howard Franklin Hirt, Ph.D.
Syracuse University, 1955

The city of Aligarh is situated at the crossing of ancient caravan routes in the Upper Ganges Plain of northern India. During its long history Aligarh has experienced the successive influences of Hindu, Moslem, and English rulers, each of whom made an impression on the city.

The objectives of this dissertation are: 1) to provide detailed knowledge of the site, situation, growth, and functional structure of Aligarh; 2) to determine if the processes by which Aligarh has grown are different from those in western cities; and 3) to determine, using Aligarh as an example, if Burgess' Concentric Zone theory, Hoyt's Sector theory, or Harris and Ullman's Multiple Nuclei theory are valid for North Indian cities.

Aligarh was founded by Hindus as a caravansary town more than one thousand years ago on a flat, poorly drained site. Eventually, by fortification and the accumulation of debris, the level of the city was raised nearly eighty feet above the plain. Today Aligarh is a railway junction, district headquarters, and industrial and commercial center with more than 140,000 inhabitants.

Prior to its conquest by the Moslems in 1194 A.D. Aligarh was ruled by Hindu Rajputs, who fortified and steepened the city's walls. The Moslems, who ruled until 1784, are responsible for the narrow, winding streets, congested residential quarters, and colorful bazaars that characterize the old part of the city. After a brief interlude of Maratha rule, in 1803 the English conquered the city. They are responsible for the Civil Lines, a westernized, upper class residential and administrative area with wide, straight streets and large houses. After the railway was built in 1864 a new industrial area developed between the old city and the Civil Lines. In 1875 a Moslem college was founded on the site of a former military cantonment, and the city became an educational and cultural center for India's Moslems.

Analysis of Aligarh's morphology, population characteristics, and land use pattern makes possible the delineation of the following functional areas: 1) areas of higher education; 2) Civil Lines residential areas; 3) district headquarters area; 4) factory, grain market, and hospital areas; 5) residential and workshop areas of the old city; 6) bazaar streets; 7) rural-urban fringe; and 8) the railway.

The processes of urban growth operate differently in Aligarh. Concentration close to the center of the city is not a strong tendency, and no Central Business District has developed. Functional segregation and the separation of residence from place of work are less developed than in western cities. Deconcentration and decentralization are relatively inoperative, since Aligarh is a small city and cheap public transportation is not available. Residential segregation due to caste and religion is very pronounced. Invasion and succession takes place less often than in western cities. Colonial subjugation, the process responsible for the Civil Lines, has no counterpart in Europe or the United States.

The Harris and Ullman Multiple Nuclei theory is valid if the following nuclei are used: 1) historic nucleus; 2) Civil Lines; 3) Cantonment, if present; 4) railway line and railway colony; 5) bazaar streets; 6) area of large scale commerce and industry; 7) Indian residential and workshop areas; and 8) district headquarters, if present. Thus modified to suit North Indian conditions, the Multiple Nuclei theory may be a useful conceptual tool.

348 pages. $4.35. Mic 56-1481

AN ANALYSIS OF THE BROILER CHICKEN INDUSTRY ON THE DELMARVA PENINSULA

(Publication No. 16,192)

Kenneth Robert Martin, Ph.D.
The University of Wisconsin, 1956

Supervisor: Assistant Professor Clarence Olmstead

Broiler chicken production has become the most important agricultural enterprise on the Delmarva Peninsula (Delaware and peninsular Maryland and Virginia) since the establishment of the industry in 1925. The purpose of this study is to analyze the spatial relationships of the Delmarva broiler industry and to establish those factors which have been responsible for the development of this significant area of agricultural specialization.

Data for this study were collected by: (1) field work; (2) personal interviews with persons engaged in various aspects of the poultry industry; and (3) questionnaires directed to hatcheries, feed mills, feed dealers and poultry processing plants. Other data were derived from state agricultural publications and the U.S. Census of Agriculture. A procedure was developed for preparing a dot map of broiler production by means of the limited census data available and the vertical air photos of the study area; this technique is described in an appendix. Other statistical maps were prepared and analyzed.

Results of this study show that the Delmarva Peninsula has no distinctive physical or locational advantage that will satisfactorily explain its success in the American broiler industry. The region acquired and has retained a position of leadership in the national broiler industry because of its early start in an area that is close to the vast markets of the metropolitan East and because of economies resulting from specialization. The economies in poultry production give the area a competitive advantage over any new areas whose development might be attempted near the large markets of the East.

Within the Peninsula broiler production has developed in those areas where relatively infertile soils, small

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farms, loss of traditional markets and reduced catch of seafood apparently created a desire to increase the family income. The lack of alternative employment opportunities in this formerly depressed agricultural area may explain the degree to which the broiler industry has been adopted.

The Delmarva Peninsula should continue to profit from its early start in the broiler business and from the extreme specialization in broiler raising that has been developed during the past thirty years. The economies of operation made possible by the high concentration of the industry within the Peninsula should play a major role in the successful continuance of the area as a major region of broiler production in the United States.

151 pages. $1.89. Mic 56-1482

INDUSTRIALIZATION IN THE MIAMI VALLEY: A CASE STUDY OF INTERREGIONAL LABOR MIGRATION

(Publication No. 16,216)

John Leslie Thompson, Ph.D.
The University of Wisconsin, 1956

Supervisor: Associate Professor John W. Alexander

The Miami Valley in southwestern Ohio is an important segment of the Manufacturing Belt of the United States. In the opinion of industrial administrators located in the Valley, two major location factors which play a significant role in the success of manufacturing are central location with respect to market and an excellent labor supply. The labor supply is unique with respect to its source. This advantage is the result of the location of this manufacturing area close to a depressed agricultural region in eastern Kentucky; thus, there is an interregional flow of labor between these two areas. Kentuckians compose thirty-six and thirty-eight per cent of the labor force of Hamilton and Middletown, Ohio, respectively. While Kentuckians are not as numerous as Ohio-born employees, their influence as a source of labor for expansion of industry and for attraction of industry to the Valley is disproportional to numbers. They provide a source of cheap semi-skilled and unskilled labor which gives the Valley its labor advantage.

The section of Kentucky from which the laborers come is a rugged, hilly area where agriculture and mining is on a subsistance level. These have aided in creating a low standard of living. Remoteness and a low level of living in turn created a clannish attitude which is evident in migration. The five counties of Kentucky from which most of the people coming to Hamilton have migrated are different than the five principal counties contributing to Middletown even though these cities are only thirteen miles apart. This difference in source is evident not only in the cities, but also within individual plants of the same company and between departments in the same plants.

The Kentucky-born worker has created industrial problems. One of these is a high degree of absenteeism. He also creates social problems in the communities in which he lives. His clannishness causes him to settle in congested areas having conditions which are often worse than those he left in Kentucky. As a result considerable social work must be done in the community. Much of the burden of this work has been undertaken by the industrial plants and has caused the label of paternalism to be applied to them.

The above statements apply to the newly-arrived Kentuckian. After the in-migrant has been in the area for a few years, he becomes a desirable citizen and a staunch, loyal employee. He has become the backbone of the labor force in many industrial plants in the Valley. One desirable trait he brings is his love of independence. This has led to less national unionism in the Valley than in most other areas of the United States. Generally speaking, most unions in the Miami Valley are independent company unions. Lack of unionization has been the primary cause of referring to the Kentuckian as a conservative laborer.

196 pages. $2.45. Mic 56-1483

GEOLOGY

CORRELATION OF DEVONIAN SECTIONS IN NORTHERN ALBERTA AND NORTHWEST TERRITORIES

(Publication No. 13,056)

Henry Gordon Bassett, Ph.D.
Princeton University, 1952

The faunas and the stratigraphy of the Upper Devonian sections exposed on Hay River, Northwest Territories, and Peace, Athabasca, and Clearwater Rivers, northern Alberta, are described in detail. The Upper Devonian Series at Hay River has been revised, and divided into three formations, the youngest of which is listed first:

the Grumbler formation,
the Alexandra formation,
the Hay River formation.

The Grumbler and Alexandra formations are defined in this paper for the first time.

The outcrop sections on the four rivers are correlated, by means of electric logs and lithologs, to the Upper Devonian subsurface section at Leduc, Alberta.

The stratigraphy of the Middle Devonian subsurface section in the vicinity of McMurray, Alberta, is described in detail. The lower portion of the series is divided into several unnamed units.

Eleven brachiopod species are described and illustrated, including one new subspecies of Athyria vittata Hall, a new variety of Atrypa clarkei Warren, and two unnamed Atrypa species which may be new.

The faunas of the Alberta Upper Devonian are compared with the Devonian faunas of Iowa and Missouri, and correlations are made with the Lime Creek, Snyder Cree, and Cedar Valley formations.

313 pages. $3.91. Mic 56-1484

MECHANISMS OF PEGMATITE EMPLACEMENT

(Publication No. 16,152)

Robert Aull Chadwick, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Eugene Cameron

Various mechanisms by which pegmatites may have come into place are considered, and the following classification of modes of emplacement, based largely on structural concepts, is suggested:

A. Non-mobile emplacement: country rocks not made bodily mobile

B. Mobile emplacement: country rocks, if any, made bodily mobile
   (A). Displacement: country rocks displaced from site of emplacement
      a. Forceful emplacement: country rocks moved aside by pegmatite
      b. Permissive emplacement: pre-existing opening in country rock filled by pegmatite
   (B). Non-displacement: country rocks, if any, not displaced
      a. Introduction: pegmatitic material introduced into site of emplacement
      b. Local derivation: pegmatitic material derived locally
         (a). Solution of pre-existing rock: pegmatite derived by chemical breakdown of solid rock
         (b). Residual segregation: pegmatite derived by crystallization of residual magmatic fluids

Criteria which may help to distinguish between these various modes of emplacement are listed and discussed. A review of the literature indicates that disagreement exists as to the worth of some of the criteria, whereas there is substantial agreement on other lines of evidence.

Results of a field study of certain granitic pegmatites of New England are also presented. The purpose of this study was to determine the modes of emplacement of these bodies by application of the various criteria developed. The mode or modes of emplacement of some of these pegmatites could be partly determined, as they exhibit critical features. The modes of emplacement of other bodies were difficult to determine because critical features are lacking.

The various pegmatites have been emplaced by several different mechanisms. Furthermore, individual pegmatites commonly exhibit evidence for more than one process. The most important mechanisms seem to have been types of mobile emplacement. The country rock was displaced forcefully to make room for some pegmatites or portions of them and displaced either forcefully or permissively at other bodies. At some pegmatites the country rock was at least partly absorbed, not displaced, by pegmatitic constituents which were introduced into the site of emplacement. 102 pages. $1.28. Mic 56-1485

GRAVITY METHODS IN IRON ORE PROSPECTING

(Publication No. 16,153)

Rodger Hale Chapman, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor George P. Woollard

The chief geophysical techniques which have been used in iron exploration have been based on changes in the magnetic field. Although very valuable for qualitative purposes, quantitative use of magnetic data is often difficult. The purpose of this study is to examine the applicability of gravity methods to the problem of iron ore exploration.

Gravity measurements have been used for a number of years in geodetic studies and in the search for oil, but until fairly recent time their use in mining geophysics has been limited. The development of modern portable and sensitive gravimeters has made gravity exploration feasible in connection with many local problems.

Basic principles and reductions, field procedure, interpretation techniques, and possible errors were examined; and a comparison made with magnetic methods. Gravity surveys over two iron deposits were chosen for purposes of study: one is a hydrothermal replacement at Benson Mines, New York, and the other is a Pre-Cambrian iron formation in the Vermilion Range district of Minnesota.

A number of individual anomalies were found in each area. These were quantitatively interpreted and discussed. Because the important anomalies were found to be small, though distinct, in most cases, it was necessary to determine residual anomaly values through the removal of regional trends. Where it was possible to check the calculated results with drill hole data it appears that the gravity data gave reasonably accurate results.

Aeromagnetic data were available for both districts. Theoretical magnetic calculations were compared with the gravity results. While some of the magnetic calculations corroborate the gravity results, others do not.

The results of the study indicate that gravity data can be used successfully in outlining important iron-bearing structures. In the areas studied magnetic data were less reliable for quantitative purposes, but were qualitatively valuable as a supplement to the gravity data.

138 pages. $1.73. Mic 56-1486

CLAY MINERAL COMPOSITION OF TILL IN NORTHEASTERN OHIO

(Publication No. 16,389)

John Brown Droste, Ph.D.
University of Illinois, 1956

The clay mineral composition and distribution in tills of Wisconsin age in northeastern Ohio were examined by x-ray and differential thermal techniques. One hundred and four samples of horizon V and horizon IV till were selected for the study. Illite is the most abundant clay mineral in every sample, chlorite is second in abundance in every sample, and kaolinite is present in some samples. The presence of kaolinite in a till indicates that it is probably Tazewell or lower Cary in age, because kaolinite is present in all but one sample of Tazewell till, in one half

of the lower Cary samples and in only two upper Cary samples.

The alteration by weathering of the clay minerals in horizon V till was also examined. In each profile ten samples closely spaced through the entire profile from fresh unweathered till to the A-soil zone were studied. Each zone in the weathering profile of till is characterized by a specific clay mineral assemblage. The well crystallized illite in the fresh unweathered till of horizon V is changed by hydration of the inter mica sheets and in the A-soil zone illite-montmorillonite mixed layers are abundant. The well organized chlorite of the fresh unweathered horizon V till is altered by hydration and reorganization of the components of the brucite sheets, and culminates in the development of vermiculite in the A-soil zone. Kaolinite is not found to change by weathering, nor is it a weathering product of the illite and chlorite.

37 pages. $1.00. Mic 56-1487

GEOLOGY OF THE CALERA MINING DISTRICT, CHIHUAHUA, MEXICO

(Publication No. 16,283)

Leonard Jacob, Jr., Ph.D.
Columbia University, 1956

This study of the Calera Mining District has two distinct objectives. The first is to provide a key to the general geology of a poorly studied region in northwestern Mexico, and the second is to shed more light upon contact metamorphism as a process of ore formation.

The Calera Mining District is located in the west central part of the state of Chihuahua on the eastern edge of the Sierra Madre Occidental. This structural province is characterized by a thick series of gently tilted Tertiary volcanic rocks, but Calera is one of a few widely scattered localities where deformed Mesozoic sediments, unconformably underlying the volcanics, have been exposed by recent erosion. At Calera Lower Cretaceous limestones and shales were deformed and eroded at the end of the Mesozoic, and then covered by a great thickness of andesites, latites and quartz latites. The geology has been further complicated by the intrusion of numerous Tertiary dikes, sills and plugs into the sedimentary and volcanic sequence. At least three generations of dikes can be distinguished as well as periods of monzonite or granite intrusion.

A contact metamorphic lead-zinc-silver ore body has been formed at the contact of a quartz latite dike and a bed of very pure limestone. The principal minerals in order of formation are: (1) epidote, ferrosalite and andradite; (2) hematite; and (3) sphalerite, chalcopyrite, pyrrhotite and galena. This metasomatic activity represents three stages: (1) a silicate stage during which iron, magnesium and silicon were introduced by high-temperature fluids of an acid and oxidizing nature; (2) an oxide stage in which hematite was formed either by the introduction of iron or by the action of alkali sulphides on the previously formed silicates; and (3) a sulphide stage during which the sulphides of lead, zinc, silver, copper and iron were precipitated from solutions carrying complex ions.

Temperatures of contact metamorphism were approximately 450°-500°C for the formation of silicates, and 300°-350°C for the formation of sulphides. Thermal metamorphic haloes, outside the zone of metasomatic action and involving the simple recrystallization of the country rock, were not formed. The depth of formation was close to 3000 feet.

Contact metasomatism was part of a continuous igneous process that began with the intrusion of quartz latite dikes and a monzonite plug. Then, by a process of differentiation within the same magmatic source, a volatile, iron-rich phase and a granite magma phase were separated and introduced along the previously established channelways. It was these acid and oxidizing volcanic fluids (gases?) which were largely responsible for the rapid reactions that took place with the limestone in the formation of silicates. In the later sulphide stage these fluids became less acid and more reducing in nature, as evidenced by the partial reduction of hematite to magnetite.

The ore body should be considered a high-temperature contact metasomatic deposit.

154 pages. $1.93. Mic 56-1488

STRATIGRAPHY AND STRUCTURAL GEOLOGY OF PORTIONS OF SOUTH-CENTRAL WASHINGTON

(Publication No. 16,538)

William Norris Laval, Ph.D.
University of Washington, 1956

In the southwestern part of the Columbia Basin Mio-Pliocene and Pleistocene formations are exposed. The Mio-Pliocene units have distinctive lithologies that can be correlated over hundreds of square miles, thus facilitating detailed structural mapping. The Mio-Pliocene formations are, from oldest to youngest, as follows: the Yakima basalt, the Selah, the Wenas basalt, and the Ellensburg. This sequence comprises a part of two mutually interfingered lithosomes – one of sedimentary rocks and the other of flood lavas. The Yakima basalt sheets and interbedded fluviatile, aeolian, and lacustrine sediments, including diatomite, record regional downwarping and mild localized warping during accumulation. The Selah formation consists essentially of fluviatile and aeolian clastics of volcanic origin derived from the present mountain areas to the west and probably to the north of the Columbia Basin. It also contains clastics apparently derived from erosion of the northern Columbia River drainage area. The Wenas basalt consists of one or two flood lava flows. Locally these flows are arbitrarily assigned to the Selah and Ellensburg formations. The basal part of the Ellensburg formation is similar to the Selah formation. Upper Ellensburg sediments consist largely of debris derived from rising anticlinal ridges. The Pleistocene Ringold formation overlies the Mio-Pliocene succession unconformably.

Petrographically the lavas are tholeiitic and are characterized by andesitic basalts and basaltic andesites. The volcanic-derived clastics of the Selah and Ellensburg formations and of the sedimentary interbeds in the Yakima basalt consist overwhelmingly of hornblende andesite. The non-volcanic sediments are quartzose sands, and conglomerates containing pebbles of quartzite, basalt, and other rock types. Mixtures of volcanic and quartzose lithologies

occur in the sedimentary lithosome and in the Ringold formation.

The anticlinal structures mapped are of three general types: (1) single, convex upward flexures; (2) broad arches with subsidiary flexures; (3) monocline-like structures bounded on one or both sides by subsidiary flexures and locally thrust to the north. In addition to thrust faulting transverse and normal faults are associated with the rise of the anticlines. More recent normal faults have slightly lowered the structural relief of some of the ridges. Two possible modes of genesis for the folding are suggested: (1) folding free of the basement, or (2) folding in direct response to deformation of the basement.

The indicated sequence of events is as follows: (1) accumulation of flood lavas and minor sedimentation accompanied by general downwarping; (2) localized mild differential warping and the accumulation of great volumes of andesitic detritus along with continued lava outpouring and non-volcanic sedimentation; (3) rise of anticlinal ridges and integration of the drainage system into essentially its present form; (4) continued or renewed differential warping and deposition of the Ringold formation; (5) upwarping of that formation to the north and perhaps nearly contemporaneous antithetic faulting.

257 pages. $3.21. Mic 56-1489

THE GEOLOGY OF THE TOPIA MINING DISTRICT, TOPIA, DURANGO, MEXICO

(Publication No. 12,606)

John Lemish, Ph.D.
University of Michigan, 1955

Topia is an old 16th century silver district in northwest Durango in which mining has recently been renewed. An estimated $10,000,000 to $20,000,000 in silver was produced mostly between 1870 and 1912. The district is in the canyon country of the Sierra Madre Occidental range which is a partially dissected volcanic plateau. At Topia and in most of the central Sierra Madre, only extrusive rocks are exposed. These can be divided into andesites and rhyolites. Late Cretaceous(?)-early Tertiary andesites of great thickness are unconformably overlain by Miocene(?) rhyolites as much as 600 meters thick. Mineralization is restricted to the andesites and related to a pre-rhyolite granodiorite stock.

Faults of different ages having northwest and northwest trends are major structural features. Three sets are recognized: (1) the major northwest set, (2) the N.60°E. set of vein fissures and faults, (3) the minor set of N.20°E. faults. The northwest and N.60°E. sets form the dominant early-age fault pattern controlling intrusive activity and mineralization. The veins and rhyolites are offset by later normal faulting that occurred along earlier trends and also formed the N.20°E. set.

Three types of hydrothermal alteration occur in the andesites: the regional propylitic, local propylitic, and quartz-sericite types. The regional and local propylitic types, essentially similar but of different age, are green-colored rocks rich in chloritic minerals. The regional type surrounding the granodiorite stock in the southwest part of the district is a widespread pervasive alteration in which three mineral assemblages were recognized and interpreted as an intensity zoning outward from the granodiorite. The assemblages in order of decreasing intensity are: (1) albite-chlorite-epidote, (2) albite-chlorite-epidote-calcite, (3) albite-chlorite-calcite. The local propylitic type characterized by an albite-chlorite-calcite assemblage forms bands up to 25 meters wide bordering every vein in the fresh andesites of the main district beyond the regional propylitic zone. The quartz-sericite type forms a narrow 30 to 60 centimeter band of grayish rock composed of abundant quartz and sericite located between the vein and propylitized andesite. The quartz-sericite type represents a more intense alteration related to the veins and superimposed on local or regional propylitization.

The ore deposits, mined primarily for silver and minor amounts of lead and zinc, occur in nine main parallel veins averaging 30 centimeters in width. They strike N.60°E. and dip 80°S. Over 40 minor veins of similar attitude are present. The major veins, one of which is 5 kilometers long, are persistent features occupying fault fissures considered to be shears. Ore shoots extend over long distances along strike but probably not to great depth although sulphide minerals are present throughout a composite vertical range of 1000 meters. Arsenopyrite, pyrite, sphalerite, and galena were deposited in that order largely by open filling. Freibergite, chalcopyrite, and ruby silver minerals were deposited somewhat later by replacement. Quartz of many generations and some late barite and calcite form the gangue. The deposits are classed as leptothermal.

Alteration and ore deposition are related to the same period of hydrothermal activity. The regional propylitization is definitely hydrothermal and not deuteric in origin. It is interpreted as a widespread, early, barren type of alteration caused by alkaline solutions rich in carbon dioxide producing intensity zones about the granodiorite as temperature decreased. A break, probably structural, occurred after this initial barren phase. Later more intense solutions caused local propylitization, quartz-sericite alteration, and vein mineralization along fissures in fresh rocks; the solutions superimposed quartz-sericite alteration and vein mineralization on pre-existing regionally propylitized andesites.

260 pages. $3.25. Mic 56-1490

MINERALOGY AND PETROLOGY OF THE SITTAMPUNDI COMPLEX SALEM DISTRICT, MADRAS STATE, INDIA

(Publication No. 11,038)

Anantharama Parameswara Subramaniam, Ph.D.
Princeton University, 1952

This dissertation embodies the results of field and laboratory studies on a group of basic rocks from the Archaean complex of Peninsular India. These studies indicate the rocks to be a part of a gravity stratified sheet, which have undergone profound metamorphic transformations after their primary crystallization from a basic magma.

Mineralogy

Ten minerals from the various rocks have been studied in some detail to elucidate the genesis of these rocks. Two garnets from the rocks of the eclogite gabbro series were found to be rich in pyrope molecule, and hence considered eclogite garnets. A garnet from the anorthosite was found to be rich in grossularite molecule with a fair abundance of the pyralmandite molecule.

The plagioclases in the anorthositic rocks were found to be mostly bytownite-anorthites. Chemical analysis of one specimen and partial spectroscopic analyses of 12 specimens, indicate them to vary in composition from An_{80} to An_{99}. It is believed that some of these rocks contain plagioclase with the highest 'An' content known so far. As anorthite feldspar was described and identified from these rocks by Count de Bournon in 1802, and named indianite, it is proposed that the name be revived to indicate natural feldspars of composition An_{90} -An_{100}, restricting the name anorthite to the end molecule hitherto unrecorded in nature. The optical studies on these feldspars have shown that the indices of refraction are sensitive to small changes in composition and hence are critical for the accurate estimation of the composition of plagioclase feldspars.

Anthophyllite occurring in some anorthosites was found to be an aluminian variety. The optical properties of this and other aluminian anthophyllites do not fit Rabbitt's curve. It is thought that the name gedrite should be retained for the aluminian anthophyllites.

The monoclinic amphiboles occurring as the principal mafic mineral in the anorthosites end related chromitites were found to be edenite and pargasite respectively, and thought to form a sub-series under the hornblende series.

The cordierite occurring in a peculiar corundum-cordierite assemblage, was found to be magnesian in composition with the normal optically negative character. An analysis of existing data from the literature on the composition and optical properties of cordierite shows that the optically anomalous character of the mineral cannot be attributed to the presence of alkalies, lime, etc., as contended by previous workers.

The clinozoisites present in the anorthositic rocks are low in epidote molecule, but show compositional variation within the same rock, and occasionally within the same crystal.

The chromite in the chromitite was found to be an aluminian variety, approaching a chromian spinel.

The corundum invariably present in the anorthositic rocks is interpreted to be secondary, being derived from the primary minerals during the two periods of metamorphism.

Petrology

The complex consists of a layered sequence of anorthosites, with chromitite and perknite bands, and eclogite gabbros. By analogy with other described occurrences of stratiform sheets, this is interpreted as a gravity stratified layered complex. The rocks of the anorthosite series are thought to represent original anorthosites, noritic anorthosites and troctolites, while the eclogite gabbros are thought to represent the gabbro facies of the original complex. The following sequence of events are postulated:

1. Emplacement of basic magma in Dharwar sediments during a period of quiescence, followed by fractional crystallization and gravitative differentiation resulting in a layered complex.
2. Chemical and mineralogical transformations of the various units of the complex, induced by the regional migmatization and metamorphism related to the formation of Peninsular gneisses. The anorthosites are amphibolized and the gabbros transformed to eclogites.
3. Elevation of the complex to present level of erosion with the accompanying retrograde changes of eclogites. Top of complex is eroded.
4. Forceful intrusion of the younger granite domes the complex resulting in its being tilted, dipping away from the center of intrusion. The mineralizers from the granite induced profound mineralogical transformations in the anorthositic rocks, resulting in the formation of clinozoisite, garnet and corundum, and the eclogites suffered further diaphthoresis.

It is proposed to call this stratiform sheet 'Sittampundi Complex' after the village near its type exposure.

247 pages. $3.09. Mic 56-1491

THE ORIGIN OF THE REX CHERT

(Publication No. 16,222)

Maurice Armond Warner, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Stanley A. Tyler

Stratigraphic, petrographic and geochemical studies of the Rex chert member of the Phosphoria formation lead to the conclusion that the bulk of the bedded chert was deposited as a finely divided chemical precipitate. A smaller amount of chert resulted from the silicification of bioclastic limestones through the action of silica bearing solutions migrating up dip from the deeper part of the basin along the more permeable beds.

Most of the chert was deposited in an east-west trending trough surrounded on three sides, at least, by more stable platform areas. The scarcity of clastics, and the greater amount of pyrite and organic matter in the chert show that these rocks were deposited under deeper, quieter waters than those that prevailed over the platform areas where the sediments are characterized by an abundance of terrigenous and bioclastic particles and a low content of organic matter and pyrite. Around the periphery of the area of silica deposition the chert grades into and is interbedded with carbonate rocks which are largely of a bioclastic nature.

The petrologic and geochemical features of most of the chert show that it was probably deposited as a finely divided chemical precipitate along with calcium carbonate in an area of minimum clastic deposition. The chemical conditions in the deeper part of the basin led to the resolution of most of the calcium carbonate and the dolomitization of much of the remainder. The good crystal form and the zonation of the dolomite rhombs present in the

chert, the nature of the silicified fossil fragments, the small amount of alumina in the chert and limestone and the similarity of the trace element ratios in adjacent samples of chert and carbonate rock support this conclusion.

Silica was found to have a solubility of 84 ppm in sea water – a value far in excess of the amount naturally present in sea water. Most of the silica carried by the rivers seems to be removed as iron and aluminum silicates in the sea under present conditions. A combination of lateritic weathering in the source area which would be likely to produce a high ratio of silica to alumina plus iron oxide in the stream waters and restricted circulation in the marine basin could lead to the saturation of the waters of the basin with silica and the precipitation of the excess silica. The presence of red beds as facies equivalents of the chert and carbonate rock and the features of the chert that are characteristic of deposition in a silled or restricted basin suggest that the conditions necessary for the accumulation of silica as a chemical precipitate existed at the time of deposition of the Rex chert.

94 pages. $1.18. Mic 56-1492

DIFFUSION OF ZINC THROUGH CARBONATE SYSTEMS

(Publication No. 16,436)

John Patteson Wehrenberg, Ph.D.
University of Illinois, 1956

The coefficient of diffusion of zinc ion from solution into single crystal calcite, in the direction of the c axis, was found to be about $3.8 \pm 1.2 \times 10^{-12}$ cm^2/sec at 40.0°C. The activation energy for diffusion was found to be 3774 ± 2400 cals. The diffusion coefficients obtained in this set of experiments were too large to be accounted for by volume diffusion, while the activation energy was found to be too small. Two possible explanations for these discrepancies are that diffusion has taken place along submicroscopic cracks or cleavages, or that diffusion has been energetically activated by the presence of some "short-circuiting" path, such as dislocations which were induced by grinding. Neither explanation is completely convincing, however, and one must conclude that these apparently anomalous diffusion rates in calcite remain an open question.

The study of diffusion of zinc in solution through carbonate rocks points up the fact that diffusion, in geological systems, is exceedingly complicated. It is dependent not only on time, concentration, temperature, and, to a lesser extent, pressure, but is also dependent upon the spatial coordinates, and the rate law or laws governing the interaction between the diffusing solution and the diffusing medium.

The most general form of the diffusion equation that may be written for this situation is

$$\frac{\partial c}{\partial t} = \frac{\partial\left(D \frac{\partial c}{\partial x}\right)}{\partial x} - f(c)$$

This law is, for all practical purposes, impalpable to mathematical solution.

One may, however, calculate an "apparent" diffusion coefficient for the system at different points in the system. This coefficient in the zinc ion – carbonate rock system ranges from 10 to 10^3 times less than the true diffusion coefficient of zinc in solution. The low value for this coefficient, and its variation with the spatial coordinates of the system, is due to the loss of zinc from the system when it exchanges with the calcium in the matrix.

Such complexity makes it impossible to extend predicted behavior from one system to another, unless both systems are similar in all essentials. It is also meaningless to extrapolate ideal behavior of ions in solution to the diffusion of matter through pore spaces in rocks, except in the most ideal, and geologically improbable, situation.

In geological situations, the "apparent" diffusion coefficient may be defined as the geological diffusion function (G). By using G under favorable, but not unattainable, conditions, one may derive useful information which may be obtained in no other way, such as the flux of matter through a rock at any one place, and the "mean velocity" of the diffusing material, which is a measure of its mobility at that place.

This concept of geological diffusion was applied to a study of wall rock alteration made by Rittman (1934). From his data, diffusion data for various oxides of the wall rock were obtained. While these diffusion data do not change the present ideas of wall rock alteration, they do serve to place them on a more quantitative basis.

When the duration of a geologic activity is not known, the factor Gt may be determined, thus giving relative indications of the mobilities of the elements or oxides involved in the activity. Of course, if it is possible to find a physico-chemically similar activity whose G values are known, one may then arrive at a good estimation of the duration of the activity.

The application of this concept of geological diffusion is limited to only those activities in which the boundary conditions can be satisfactorily determined, i.e., to short range diffusion, such as wall rock alteration, diffusion across igneous contacts, or diffusion in small scale metamorphic differentiation. 81 pages. $1.01. Mic 56-1493

HEALTH SCIENCES, PATHOLOGY

DEOXYRIBONUCLEIC ACID BIOSYNTHESIS IN REGENERATING LIVER

(Publication No. 14,765)

Liselotte Isabella Hecht, Ph.D.
The University of Wisconsin, 1955

Supervisor: Professor Van R. Potter

It has been recognized that in the synthetic reactions, such as nucleic acid synthesis, intermediates are utilized that also serve a number of other metabolic functions. The factors regulating the availability of intermediates for these reactions may be recognized after the sequence of the synthetic reactions has been elucidated. It was undertaken to study the pathways of nucleic acid synthesis in a tissue in which a somewhat synchronous response to a growth stimulating factor could be observed. Regenerating rat liver has been described as a good test system for such a study. A synchronous response of the liver following partial hepatectomy has been demonstrated using the incorporation of orotic acid-6-C^{14} into deoxyribonucleic acid (DNA) as a criterion. An interval of 18 hours was observed before DNA synthesis started, and after this initial period a maximum rate of DNA synthesis occurred 24 to 30 hours post operative. Four to six hours before the beginning of DNA synthesis a change in the extent of the utilization of orotic acid for the synthesis of ribonucleic acid (RNA) was observed. The timing of these reactions was of particular interest in view of the close interrelationship of the pathways of RNA and DNA synthesis that are becoming apparent.

The fact that the incorporation of C^{14} into DNA did not begin until 18 hours after partial hepatectomy, regardless of the time of the injection of the precursor, led to the recognition that a common intermediate for RNA and DNA synthesis remained available during this time. Attempts were made to identify the possible connections between the RNA and DNA precursors. Examination of the acid soluble fraction of regenerating liver revealed that labeled orotic acid and acyclic precursors of orotic acid were not present a short time after the injection. No accumulation of labeled deoxyribonucleotides occurred and the small quantity of deoxycytidine present did not contain appreciable amounts of radioactivity indicating that these compounds could not be formed by direct condensation of orotic acid and deoxyribose phosphate. The available radioactive compounds were the uracil and cytosine ribonucleosides and ribonucleotides present at all levels of phosphorylation and in the form of coenzymes. A correlation between the incorporation of the injected precursors into the acid soluble pyrimidine ribonucleotide pools and the pyrimidines of RNA and DNA, during a short period after the injection of the precursor, led to the following conclusion. During that phase of the mitotic cycle of a cell in which DNA synthesis occurs the immediate precursors of DNA are derived from the common pools of intermediates that serve as a source for the immediate precursors of RNA and the various coenzymes, and are present at all times in the normal, resting liver. The indirect evidence presented points to a direct conversion of a specific ribonucleoside phosphate to the corresponding deoxyribonucleoside phosphate, and the formation of deoxyribonucleosides is considered to be a side-reaction. The fact that the deoxyribomononucleotides are phosphorylated in vitro in the presence of the cytoplasmic fraction of regenerating liver shows that mechanisms are available for the formation of intermediates that may be the postulated precursors of DNA.

136 pages. $1.70. Mic 56-1494

HEALTH SCIENCES, PHARMACY

THE PERMEABILITY OF RED CORPUSCLES TO VARIOUS SALTS

(Publication No. 16,368)

Charles William Hartman, Ph.D.
The University of Florida, 1956

In the present investigation, the hemolytic method was used to determine the van't Hoff isotonic coefficient (i value) for various salts in order that these values might be used in the preparation of isotonic solutions. Other methods of determining i values for use in the preparation of solutions isotonic with blood are not always reliable.

Experiments were conducted using rabbit blood and human blood in order to determine the i value of various electrolytes. These values obtained by the hemolytic method were compared with i values which were calculated from activity coefficients and osmotic coefficients and from freezing point data.

Using salts which contained either a divalent cation or divalent anion gave i values which were considerably higher than i values calculated from activity coefficients and freezing point data. It was thought that these high i values were due to leakage of electrolytes from the erythrocytes. The slightly high i values obtained for sodium salts also seemed to indicate electrolyte loss from the red cells. Potassium salts gave lower i values by the hemolytic method than those calculated from colligative property data. These lower i values were thought to be due to penetration of the red blood cells by potassium salts.

By the hemolytic method, zinc sulfate gave apparent i values which were much higher than would be expected from theoretical considerations. This discrepancy was thought to be due to the action of the zinc salt on the red cell membrane making the cell more resistant to hemolysis.

163 pages. $2.04. Mic 56-1495

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm; and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

HEALTH SCIENCES, PUBLIC HEALTH

A STUDY OF THE RESPONSES OF A GROUP OF ADULT FEMALE LISTENERS TO A SERIES OF EDUCATIONAL RADIO PROGRAMS (VOLUMES I AND II)

(Publication No. 12,210)

Carlton Fredericks, Ph.D.
New York University, 1954

The investigator, engaged himself in health education by radio, found this medium for such education to have received no critical study, despite the enormous amount of time and effort devoted to this subject on the air.

Authorities in the industry were agreed that radio has a high potential in this area, and further agreed that the potential had probably never been achieved. Related studies, in the main, were devoted to captive audiences previously exposed to transcriptions under laboratory or classroom conditions. No study of the responses of a voluntary audience to a radio health education program under everyday commercial broadcasting conditions had been made.

This study was confined to a random sampling, comprising 5000 of the listeners who corresponded with the broadcaster in a decade. From the 622 useful responses to this procedure the socio-demographic structure of the audience was established. This group was reduced to 213 individuals, preserving the structure of the original 622 in age, sex, marital status, religion, income, etc. These individuals were interviewed personally and their attitudes, beliefs and practices in nutrition, the variable of choices in the study tested. Analyses of their diets and inventories of their pantries were compiled. These responses were compared with those of a control group of 210 individuals, selected from the same neighborhoods, by procedures which yielded the same frequency distributions of the socio-demographic characteristics previously cited.

The homogeneity of the groups was satisfactory, not only with regard to these characteristics but to occupations of husbands and other structuring in which matching had not been sought, leaving the fact of listening to the programs the characteristic signally distinguishing the experimental subjects from the controls. By testing specific hypotheses it was demonstrated that the behavior and beliefs in nutrition of the listeners were significantly different from those of the controls and significantly parallel to the instructions in the broadcasts.

Comparisons of the characteristics of the listeners as compared with the Census population and those of the control group, and comparisons of the responses in the testing instruments, were made by testing of means, medians, analysis of variance, and rank order correlation, using Student's "t" Distribution, Snedecor's F Test, and the Spearman coefficient, where applicable.

The fidelity established between the beliefs and practices (stated and observed) of the listeners and the teachings of the broadcaster was such as to demand, under the conditions of the study, conclusion of a casual relationship between the fact of listening and the behavior and beliefs of the audience. The possibility that these beliefs and practices preceded the fact of listening was rejected as highly improbable.

The study demonstrated that health education by radio in this instance has been effective. It indicates further that the receptiveness of the radio audience to highly technical instruction is greater than may be supposed. It shows that the radio listener can be motivated into changing health habits, with special reference to nutrition, by radio education.

The principal lesson taught by the study is concerned with the nature of the instructions: it was found that directives which are generalizations are not likely to be followed, where specific instructions are.

Conversely, it was found that a dichotomy between beliefs and practices is strongly apparent in an area of health habits where pleasures of the palate vie with the physiological demands of the organism.

The study clearly invites further exploration in depth to ascertain more definitively the constituents of radio health education which make for the achievement of the full potential of the medium.

350 pages. $4.38. Mic 56-1496

HISTORY

HISTORY, GENERAL

THE PUBLIC CAREER OF ELBRIDGE GERRY

(Publication No. 15,851)

Eugene Francis Kramer, Ph.D.
The Ohio State University, 1955

The dissertation represents the first full-scale study of Elbridge Gerry's public career. It considers his work as a leader in Massachusetts in fomenting the Revolution, delegate to the Second Continental Congress, signer of the Declaration of Independence, member of the Federal Constitutional Convention, Congressman (1789-1793), minister to France during the XYZ Affair, Governor of Massachusetts (1810-1812), and Vice-President of the United States (1813-1814). The major emphasis is on the national career. Manuscript sources used in preparing this paper include the collections of the New York Public Library, Massachusetts and Pennsylvania Historical Societies, and the Library of Congress. Biographies, standard monographs, writings of leading men, and public documents round out the study.

Elbridge Gerry was a controversial figure and did not fit into any set pattern. He did not join a political party until late in his career, when he became a Republican. Even then, he remained aloof to practical politics and party organization. Economically, Gerry was a

Hamiltonian, and favored sound money, a national bank, and centralized fiscal management; otherwise, he vigorously supported states rights and opposed any increase in the powers of the national government. Democracy was inherent in his thinking, but it was rarely practiced, probably because of a narrow New England background and outlook. In foreign affairs, Gerry was interested primarily in maintaining peace and carrying on business as usual, a theory which shaped his conduct during the XYZ Affair. The New Englander was personally cool toward his associates except for a small circle of friends, which included John Adams. He doubted the people's ability to rule and was suspicious of individuals with new ideas.

205 pages. $2.56. Mic 56-1497

HISTORY, MODERN

NORRISTOWN, PENNSYLVANIA: 1900-1909

(Publication No. 16,315)

Harry Robert Beck, Ph.D.
University of Pennsylvania, 1956

Supervisor: Wallace E. Davies

This dissertation is one of a series that is being done under the auspices of the Behavioral Research Council of the University of Pennsylvania. This group has been conducting a study of Norristown, Pennsylvania, in the first half of the Twentieth Century to ascertain the effects of technological change on social adjustment in the community.

The purpose of this dissertation is to study the general history of Norristown in the first decade of the present century. The later decades of the community's history will be investigated in subsequent dissertations. Therefore, the general history of the community will be known in fairly broad detail, so that the other aspects of the study of technological change may be considered in relation to it.

The source materials for the history of the community are marked by their scarcity. The best sources are the town's newspapers, and such material as can be utilized from the Census of the United States. Aid may also be had from dissertations that have been completed in the study of Norristown. The Daily Herald and The Daily Register were the papers utilized. The former was the Republican organ of the community, and the latter was the voice of the Democratic Party. Both were consulted in order to obtain an accurate impression of local politics.

The study of the economic history of the decade showed a respectable amount of growth and indicated that the community possessed a fairly stable economy. It was a town devoted mainly to the textile industry, although there was some diversification with strong secondary industries of which the tobacco and woolen goods industries were the largest.

The political life of the community was very active, but marked by the complete domination of the Republican Party. Only the Fourth, Fifth, and Ninth Wards voted for the Democratic Party with any regularity. Nevertheless, the political life of the community was remarkably free of the taint of corruption.

The social life of the borough was also investigated. The middle and upper classes had a great many diversions to occupy their free time, but the activities of the lower class were less well recorded. The local theater, motion picture establishments, tennis clubs, and various other social organizations gave an outlet for people in their leisure hours.

The three educational agencies of the community were the churches, the libraries, and the public schools. All three were very active in the decade, and seem to have accomplished their missions with a fair degree of success.

The two serious problems of the decade that were not met with any great success were those of crime and public health. The usual crimes common to a small town were recorded, but the observer is startled at the prevalence of drunkenness. The public health problems had their roots in inadequate sewage disposal and lack of garbage collection. The large number of communicable diseases recorded in the decade testifies to this. Gestures were made toward solving these problems, but no great success was recorded in the decade.

The borough had many problems which it attempted to solve. Its efforts were not always adequate as in the matters relating to public health and crime, but, in general, Norristown made progress in coping with the problems of a growing community. 227 pages. $2.84. Mic 56-1498

VINCENT BENEDETTI, FRENCH AMBASSADOR TO BERLIN, 1864-1870

(Publication No. 16,326)

Willard Allen Fletcher, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. L. M. Case

The diplomatic mission of Ambassador Vincent Benedetti to Berlin represents an important aspect of French diplomacy in the latter part of the Second Empire. It witnessed both the gradual establishment of Prussian hegemony in Germany and the eventual fall of Napoleon III's empire. The appointment of the veteran diplomat was primarily occasioned by French fears of a revival of the Holy Alliance. The past collaboration of the two German states was expected to continue and it was even feared that Russia might become a member of this new constellation of powers. An alliance of the three monarchies could easily check French territorial ambitions in Europe and severely hamper the emperor's dream of national aggrandizement. To break up the threatening coalition, then, the imperial government was anxious to seize upon Bismarck's aspirations in Germany as a means for promoting an Austro-Prussian estrangement.

Benedetti was considered well suited for the task the French government had set itself in Germany. An experienced diplomat and a foe of Austria and the old order she represented, he was expected to be thoroughly sympathetic to a policy which would lead to the isolation of Austria and the destruction of the Vienna Congress system of 1815.

An ardent supporter of French expansionism Benedetti would welcome an opportunity to keep Austria and Prussia apart and promote instead Franco-Prussian collaboration.

The harmony between Austria and Prussia was short-lived and the expectations of the French government were apparently destined for an early realization. The task of the ambassador was comparatively easy since the Prussian cabinet seemed anxious to win the support of France for its far-reaching ambitions in Germany. Indeed, Benedetti soon came to believe that an Austro-Prussian conflict would be inevitable, in view of the nature of the rivalry, and he cautioned his government repeatedly against entering into an alliance until the course of events assured success. The Gastein convention was but a temporary setback for French policy; the clash of arms at Sadowa punctuated the break between Austria and Prussia.

The magnitude of the Prussian victory and the political consequences of this decisive development led to the presentation of French compensation demands. The collapse of Austrian military power had abruptly changed the balance of power and the French government was anxious to offset Prussia's gains and realize at the same time its long-cherished territorial ambitions. The second phase of Benedetti's career was devoted almost exclusively to the compensation issue. The defeat of the French hopes at London in May 1867 ended a long series of negotiations during which the ambassador's determination to redress the balance of power was not matched by either the emperor or the foreign minister.

The final phase of Benedetti's mission witnessed a very pronounced change in the ambassador's attitude. He considered all chance of Franco-Prussian collaboration irretrievably lost and watched with misgivings the trend toward a further disturbance of the equilibrium, as revealed in Bismarck's unification schemes. His dispatches were filled with warnings and with demands that France prepare for a possible war with Prussia. He even advocated a rapprochement with Austria – an indication of Benedetti's apprehensions. Yet, his warnings went unanswered and the sudden outbreak of war in July 1870 found France unprepared to parry the thrust of the Prussian arms.

As ambassador to Berlin Benedetti played an important part in the implementation of French policy in Prussia and Germany. An account of his mission, based upon extensive documentary evidence collected in various European archives, not only sheds additional light upon imperial foreign policy but also permits an evaluation of Benedetti's effectiveness on the basis of the sum total of his activities.

543 pages. $6.79. Mic 56-1499

THE HISTORY OF ARTICLE VII OF THE TRIPLE ALLIANCE, 1875-1915

(Publication No. 16,343)

Wilhelm Reuning, Ph.D.
University of Pennsylvania, 1956

Supervisor: L. M. Case

The history of Article VII is a discussion of the basic Balkan clause of the Triple Alliance which governed the relations between the Dual Monarchy and Italy in the western Balkans and the Ottoman coasts and islands of the Aegean and Adriatic seas from 1887-1915. It was an agreement between two powers who, being enemies by tradition, vital interests, and background, believed it to be mutually more advantageous to be allied than to go to war with each other. As this clause was never really based on friendship between either the governments or the public of the two countries, it was always a superficial thing and rested on necessity, practicality, and the common Austro-Italian interest of opposing the Slavic advance in the Balkans.

While from 1887-1896 and during the Balkan wars cooperation under Article VII existed to a greater or lesser degree in order to realize these ends, the lack of genuine amity between Austria and Italy within the framework of Article VII made its existence rather precarious. Direct and indirect violations of the spirit, the letter, or both, of Article VII were frequent and both powers sought to circumvent their obligations toward each other whenever possible. This was most noticeable in the Macedonian reform question, the Cretan affair, Italy's relations with Serbia and Montenegro, the Bosnian crisis, the Racconigi agreement, the Tripoli war, the history of Albania during the first half of 1914, World War I, and all Austrian or Italian economic projects in the Balkans. On the whole both powers approached the execution of the terms of Article VII in a negative sense. When this approach was no longer possible and the Slavic threat to Italian interests had disappeared, the agreement collapsed.

Since direct accounts of Austro-Italian relations under Article VII are to my knowledge nonexistent and indirect accounts can be found only incidentally in memoirs and in general works dealing with European diplomatic history, this dissertation approaches the subject mainly through documentary sources. Unfortunately, the writer was not able to use the unpublished Vienna archival material and the Italian diplomatic correspondence. However, in order to be as objective as possible the attempt has been made to fill these gaps by the utilization of the printed German, Serbian, and English diplomatic documents.

The collected information leads one to conclude that the basic controversy in the Balkans between Austria and Italy rested mainly on differences of traditions, vital interests, and background. This resulted in clashes between the two powers in the various Balkan areas and in the interpretation of the terms and principles of Article VII. One cannot, therefore, blame either power for its obvious disloyalties toward the other and must not judge their actions in that light.

572 pages. $7.15. Mic 56-1500

THE SECOND BANK OF THE UNITED STATES UNDER TWO CHARTERS: PART I: THE BANK UNDER A NATIONAL CHARTER PART II: THE BANK UNDER A PENNSYLVANIA CHARTER

(Publication No. 15,685)

George Ernest Shortt, Ph.D.
University of Michigan, 1929

Part I

The establishment of the Second Bank of the United States, chartered during the final months of the chaotic financial situation existing during the War of 1812-15, coincided with a return of prosperity, but, like its predecessor, the Second Bank of the United States was opposed by many as unconstitutional, and to this the lax administration of the Bank's first president and the sudden panic-bred retrenchment which brought about the ruin of thousands added many implacable and persistent enemies so that, when re-charter was sought in 1832 and a bill to this effect was passed by Congress, President Jackson possessed sufficient popular support to veto the measure. Bitterness and acrimony were increased during the election of 1832, in which re-charter became a political issue, and the president, on re-election by an overwhelming majority, made war on the Bank, while Nicholas Biddle, the president of the Bank, fought back with such weapons as he could find. However, the tide eventually turned against the Bank and, despairing of re-charter, the Bank, a few months before its charter was due to lapse, sought refuge under a Pennsylvania charter, called the Bank of the United States of Pennsylvania, and was thus able to keep its capital intact.

Part II

This second part is the newer and more important part of the work. It is based upon the correspondence of the banking firm of Baring Brothers, London agents of the Bank, whose European colleagues, Hottinguer & Cie, of Paris, and Hope & Co., of Amsterdam, were also drawn into the debacle. The Barings corresponded regularly with their American representative, Thomas Ward, and the President of the Bank of the United States, as well as various other American firms.

Biddle sent Jaudon, an officer of the Bank, to London to raise money through Baring Brothers and to deposit with them for future sale state securities which were then unsaleable. The Bank immediately began to draw against the unrealized proceeds of these securities. Finally the Bank of England took alarm at the drain of specie – then amounting to sixteen millions – and a general tightening took place which placed many of the big London firms in the American trade in danger of collapse.

Baring Brothers continued to protect the credit of the Bank of the United States by accepting its drafts, but Hottinguer and Hope were more reluctant. Finally the overtrading of 1835-36 resulted in a general suspension of specie payments in the United States in which the Bank joined. The President's party accused the Bank of having brought the suspension about deliberately for political purposes, and the Bank party declared it was due to the President's mad measures against the Bank. It is true the Bank Party hoped suspension would lead the Government to recharter the Bank as a rallying point for resumption of specie payments, but President Van Buren, although less hostile, refused to depart from the policy of his predecessor.

The New York and Boston banks made repeated efforts to resume specie payments but the Bank of the United States was opposed to resumption. Nevertheless the New York banks finally achieved resumption, followed slowly by those of New England and, after some delay, the Bank of the United States was forced to follow suit.

Meanwhile the Bank's London operations finally led to a break with the Barings, and Mr. Jaudon was sent over to London to raise funds independently as best he could.

Between crises Nicholas Biddle resigned the presidency of the Bank declaring it was so prosperous his services were no longer needed.

The Bank plowed on, continuing to overdraw on Hope and Hottinguer now that Barings were out of the picture, apologizing afterward, and repeating when necessary. Eventually the Bank fell back upon meeting local obligations by drafts on its European agents, meeting the drafts either by bargain sales of Bank stock and state securities in Europe or by issuing equally questionable drafts on others.

In October, 1939 the New York office of the Bank of the United States suspended specie payments again and was followed by the Philadelphia banks, but the New York and Boston banks remained steady. Jaudon's sales and borrowings kept the Bank semi-solvent for eighteen months and its shares still commanded a price. There was even hope the Bank might yet be saved but Ward and others better informed continued to believe otherwise.

In 1941, with a great deal of assistance, the Bank once more resumed specie payments, but it did not have the ability to maintain them. On Feb. 6th the Bank suspended for the last time and finally sank into a state of insolvency.

452 pages. $5.65. Mic 56-1501

THE LIFE OF REVEREND JOHN A. ZAHM, C.S.C.: AMERICAN CATHOLIC APOLOGIST AND EDUCATOR

(Publication No. 16,546)

Ralph Edward Weber, Ph.D.
University of Notre Dame, 1956

Father John A. Zahm (1851-1921) was the most notable American Catholic priest within the highly competent group of Christian apologists who realized that knowledge was the sole weapon generally recognized in the conflict between Christianity and scientific agnosticism. In his aggressive leadership, whether it was for the university formation of scholars, religious and lay, or the construction of college libraries; or the preparation of intelligent articles on dogma and science to be published in such leading Catholic periodicals as the American Catholic Quarterly Review and American Ecclesiastical Review and the Popular Science Monthly, or comprehensive volumes ranging from Sound and Music through Bible, Science and Faith, Following the Conquistadores, to Great Inspirers, his goal was ever the constant quest for Truth and an intelligent faith.

With expert skill, Father Zahm discussed the theological questions raised by men of science, and he defined a

a liberal interpretation of evolution by emphasizing the possibilities of a theistic evolution, a theory of development which held that God began and controlled creation although using secondary agents in subsequent processes of development. Summer School students, who called him the "Mivart of America," at Plattsburg, New York and Madison, Wisconsin, listened intently to his intelligent presentation of science and dogma. In publicizing Catholic men of science such as Pope Leo XIII, Louis Pasteur and Pierre Joseph Van Beneden, he acquainted Catholic and Protestant readers with living examples of deeply religious scientists. His book, Bible, Science and Faith was read by thousands of students and seminarians, perplexed by dogmatic questions: his Evolution and Dogma, prohibited by the Sacred Congregation of the Index in 1898 during the difficult times of the Americanism question, also sought to give probable answers to the troublesome problems posed by honest men of science, and at times, by their less worthy popularizers. Father Zahm's subsequent apologetical writings centered about the history of South America. Under his guidance, the pioneering Roosevelt expedition to South America began and the favorable books and publicity that resulted increased the understanding and mutual respect between the two continents.

Too, this story is a chapter in the history of the University of Notre Dame and the Congregation of Holy Cross for Father Zahm was both their son and inspirer. Especially after his ordination in 1876, Father Zahm enthusiastically commenced his program to improve the University's facilities and scholastic depth. As a result of his work, the Notre Dame football team played the first night game under electric lights in the fall of 1881 and Notre Dame was the first college campus to be lighted by electricity. Believing the study of science indispensable to the educated man, he purchased some of the best machines and equipment for the study of Physics at the Philadelphia Exposition of 1876. Science Hall, built in 1884 at Notre Dame, was the result of his personal campaign for better educational facilities and it embodied the best equipment for the study of science.

As Vice-President of Notre Dame between 1885-1892, he continued the construction of a true university, one which could compare favorably with a Padua, or Heidelburg, or a Bonn. As Provincial of the Holy Cross Congregation, 1898-1906, he enlarged the House of Studies, which he had founded in 1895, for his seminarians in Washington, D.C. in order that they might become truly educated men and capable teachers. He believed in the necessity of graduate training in the specialized study of knowledge which he deemed a prime prerequisite for the formation of scholars. His vision and awareness of scholarship awakened an intense intellectual vitality within his Congregation and he brought it ever closer to being a community of saints and scholars.

As American as Theodore Roosevelt and Archbishop Ireland, Father Zahm was an aggressive man, dedicated to scholarship and deeply aware of the power of grace and knowledge in the world of intellect. His ultimate frame of reference was the Eternal Truth.

522 pages. $6.53. Mic 56-1502

THE CRITERIA USED BY HOMEMAKERS PURCHASING LOW-PRICED, COTTON HOUSE DRESSES IN TWO LAFAYETTE, INDIANA, STORES

(Publication No. 16,469)

Coradel Hamilton, Ph.D.
Purdue University, 1956

Major Professor: Clee Fitzsimmons

This is a study of the criteria used by purchasers in selecting low-priced, cotton, house dresses in two Lafayette, Indiana, stores, the extent to which these dresses met specifications included in the standard for housework dresses formulated by the American Home Economics Association,[1] and how they performed in use.

The purposes of the study were to obtain information regarding: (1) what such terms as quality, good value, durability, serviceability, and becomingness mean to house dress purchasers and what characteristics of material, workmanship, design, and fit they believe indicate these qualities; (2) how purchasers recognize the qualities they seek; (3) the extent to which the criteria used in selecting house dresses varies among purchasers and the factors responsible for the variation; (4) the extent to which preferences reported in "The Consumer Speaks – About House Dresses," a study sponsored by the American Home Economics Association,[2] were used by these purchasers; and (5) purchasers' satisfaction with house dresses purchased.

Data concerning the criteria used by purchasers in selecting house dresses were obtained through interviews with purchasers at the time the dresses were purchased. Data concerning the extent to which the house dresses met the specifications included in the standard for housework dresses were collected by comparing samples of house dresses with the Standard. Data concerning how house dresses performed in use were collected by subjecting samples of house dresses to a year's wear test and then examining the dresses visually and in the laboratory for evidences of wear.

Effects and interactions among the criteria, store of purchase, and: (1) age of purchaser; (2) size of dress purchased; (3) occupation of purchaser's husband; (4) employment status of purchaser; (5) intended use of the garment; (6) previous purchases of house dresses in the same store; (7) previous wear of house dresses sold under the same brand name; (8) age of purchaser and size of dress purchased; and (9) age of purchaser and husband's occupation were investigated by using the analysis of variance technique. The analysis of variance technique for paired comparisons was used to investigate the relative importance of the criterion included among the criteria. To obtain

information concerning the characteristics purchasers considered indicative of the qualities they desired, percentage distributions for individual characteristics were investigated with the use of arc sin percentages.

To find out how purchasers recognize the qualities they seek, their buying practices were investigated. To find out something about the ability of the dresses to withstand wear, breaking strengths for individual garments and the component parts of individual garments were compared with breaking strengths for samples of the original fabrics.

Although there were significant differences among the criteria purchasers used in selecting low-priced, cotton, house dresses and in the emphasis placed on the criterion included among the criteria, none of the factors investigated were responsible for the differences. Significant relationships did exist among the criterion included and the order of relative importance with which it was considered. Under each of the classifications of criteria investigated, it was found that purchasers considered certain characteristics more indicative of the qualities they were seeking than others.

The investigation of purchasers' buying habits revealed that to obtain the qualities they desire, purchasers depended on previous experiences. If they had had no previous experiences with the store or brand name, they tried on the garment, inspected its workmanship, and asked sales persons questions about it.

More purchasers were satisfied with garment features than were satisfied with fit.

The comparison of house dresses with specifications included in the Standard for housework dresses and the subjection of the same garments to a year's wear test revealed no consistent relationships between garment performance in use and specifications met. However, the garments did vary significantly in their ability to withstand wear. 269 pages. $3.36. Mic 56-1503

1. American Home Economics Association, "Tentative Standard C. H. – I, Housework Dresses: Cotton" (Washington: American Home Economics Association, 1950). (mimeographed).

2. Alice Sundquist and Mary C. Whitlock, "The Consumer Speaks – About House Dresses," Journal of Home Economics, XXXVII (November, 1946), 562-568.

JOURNALISM

THE TELEGRAPH EDITORS: A STUDY OF COMMUNICATION BEHAVIOR

(Publication No. 16,164)

Walter Gieber, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Ralph O. Nafziger

This study examined the factors controlling the selection of telegraph news from the press association wires for the daily newspaper.

Kurt Lewin's "social channel" theory was applied to the selection process and the constellation of personal and operational factors in the channel of wire news was studied. Further, the wire editor's job was seen as a role which, according to Westley and MacLean, was centered on the task of transmitting information lying outside the reader's immediate environment.

Case studies were made of the operation of the wire desks in 16 small- and medium-sized afternoon daily newspapers using the Associated Press wire only. Interviews with the telegraph editors provided data on: (a) personal history; (b) assigned duties and procedures for managing the wire desk; (c) the wire editor's perception of the newsroom, the community, and readers, and (d) news policies and factors of news judgment. The wire content of the newspaper, arranged in content categories, provided a statistical sample of the AP wire. An analysis of newspaper space devoted to telegraph and other editorial classifications also was made.

A check list of news criteria obtained from the interview schedule was established and each incoming wire story was audited for agreement or disagreement and entered into a 2 x 2 table.

The 16 newspapers used 51 per cent of the items on the AP wire. Generally the wire editors were using "good" samples of the wire. Analysis of newspaper space indicated that most newspapers used wire news either according to a predetermined number of columns or as a "space filler," dependent on flow of news in other editorial classifications.

The content audit showed that selection generally was in agreement with the wire editors' criteria of news. Major exceptions occurred in the handling of crime and accident and economic items. However, the news values held by the editors generally formed a broad and diffuse pattern that permitted easy entry of wire items into newspaper pages.

The economic realities of publishing appeared to be the primary force in the operation of the telegraph news gateway. The compositors, not the wire editors, controlled the flow of copy. Further, the pressure to fulfill the demands of the back shop prevented the wire editors from doing more than the most meager copyreading and editing.

Another significant force was the Associated Press. The press association has become the primary recommender of the important news of the day for the 16 wire editors. The wire editors did some selecting among the less-important news items and generally they accepted those stories they considered to be "objective."

The wire editors perceived the newspaper readers as stereotypes – members of static economic interest groups. The wire editors had little contact with the community other than the normal social outlets.

Pressures exerted by the publisher, editorial supervisor, or any community groups generally were not important factors in the selection process. The wire editors usually accepted their employers' biases as another operational detail. The wire editors' own

biases did not appear to influence the selection process.

Most of the wire editors felt they had discharged their duty when they selected the important news from "what came in." Several wire editors described their work as a "day-to-day" routine, mechanical in nature and without intellectual demands.

635 pages. $7.94. Mic 56-1504

LANGUAGE AND LITERATURE

LANGUAGE AND LITERATURE, GENERAL

DRAMATIC AFFINITIES IN THE LIFE AND WORK OF JANE AUSTEN

(Publication No. 16,112)

George Donald Gleason, Ph.D.
State University of Iowa, 1956

Chairman: Professor W. R. Irwin

At the end of the eighteenth century in England the public showed a marked increase of interest in the theatre. The law ceased to regard strollers as vagrants, and justices were permitted to license productions in the provinces of theatrical pieces which had appeared at the London patent theatres. This increased liberty accorded the stage encouraged the construction of theatres in the provinces and was no doubt in part responsible for the strong interest taken in private theatricals by the nobility and the middle class.

Jane Austen participated to some extent in all forms of the contemporary theatric mania. The school she attended at Reading was close to the Reading Grammar School which, under Dr. Valpy, was to become famous for its theatricals. Theatricals were given during the 1780's at the Austen home at Steventen, and the Austens apparently did a considerable amount of play-reading. Jane Austen became familiar with the provincial theatres at Bath and Southampton and perhaps with those of some other provincial towns. When Jane Austen went to London, a visit to the theatre was usually part of the trip.

Among the minor works of Jane Austen are three short dramatic pieces which were written when the theatric fever was at its height. These pieces are derivative, and their chief value is the indication they give of Jane Austen's early interest in the drama and dramatic form.

Jane Austen uses the theatre in all her novels -- in most cases as a novelist's device to bring characters together. It is only in "Love and Freindship" and in Mansfield Park that dramatic influences are found. In writing "Love and Freindship," a burlesque of tragedy, Jane Austen borrowed heavily from Sheridan's The Critic and incorporated what appears to be firsthand information of the life of strolling players. The theatrical sequence of Mansfield Park was probably based on the Steventon experiences with private theatricals. The novel also reflects the critical attitudes the moral press took toward private theatricals when the fashion was at its height. 274 pages. $3.43. Mic 56-1505

THE LUXURY OF DOUBT: A STUDY OF THE RELATIONSHIP BETWEEN IMAGERY AND THEME IN EMILY DICKINSON'S POETRY

(Publication No. 16,445)

Norman Gregor, Ph.D.
The University of New Mexico, 1956

Emily Dickinson's protagonists, when they are the most moving and have the greatest complexity of reality, are caught between the agony of death and the agony of life. Analogous terms are non-being and being, sterility and fulfillment. Renunciation is a major pattern but in the act of renunciation the Dickinson protagonist may be discerned grasping for fulfillment. Similarly when she strains toward fulfillment, she can simultaneously yearn for negation. When the subject is life, her talk is tinged with death; and when she is speaking of death, her words have the savor of life. This hovering is part of her luxury. Though the fusion of opposites may be the goal, the central tenet in her strategy is never to reach the goal but to hover in an "everlasting eroticism," forever on the lip of death or of life. Her tortures are a discipline of fear for the sake of fulfillment.

One means of throwing the protagonist's hovering into relief has been to show the similarities which all the poems handled have to one poem, "The Final Inch," — a touch-stone for all of her finest work. "The Final Inch" is Emily Dickinson's complete five act play, and the other poems are considered as fragments or as variations upon her key drama. The typical "final-inch" type of protagonist is a victim of an irrestible force. The enemy slowly approaches the victim, who is in a delirium of doubt whether she will live or die. The climax can take one of three forms, a death sentence, a doubtful sentence or a reprieve.

Each chapter is devoted to examining the protagonist's ambiguously fearful desire for what ideally are entranced states, conditions of such exaggerated being that they resemble non-being, i.e., the transfixed states of shock, consciousness, reverie, satiety, love and death. Emily Dickinson does not fear and desire the extremes of these states as much as she fears and desires the approach, the paroxysms of vitality at the rim from which the protagonist may plunge into the heart of the entranced state. As a result, the poems are enacted in realms of delirium: in the realms of agitated grieving and exulting (approaching shock), agitated realizing (approaching consciousness), agitated remembering (approaching reverie), agitated tasting (approaching satiety), agitated loving and agitated dying. All of these states are potentially redemptive, all analogous to paradise. They differ in degree rather than

kind. The attractiveness of each of these miniature paradises varies considerably. The climb through these various states is like the ascent of the mercury in a thermometer. The most devastating experiences (like shock and consciousness) are at the zero point, and the most ecstatic (like love and death) approach the boiling point of paradise.

Even the smallest of her paradises are feared because any experience fraught with vitality is suspect. Such fear is the concomitant of stealth, masochism, sadism, paranoia and torture, tendencies in the poetry which have been strangely under-rated by criticism, but which convulse and inform the best of her poetry.

The area of agreement which this writer shares with other critics of Emily Dickinson, like Yvor Winters, R. P. Blackmur and Allen Tate, is considered last. One extensive full-length study, by Richard Chase, is given special emphasis because his book touches most centrally on my point of view.

Early admirers tended to emphasize the delightfulness of Miss Dickinson's whimsicality. More akin to contemporary criticism, this dissertation emphasizes the luxury of Miss Dickinson's torture.

323 pages. $4.04. Mic 56-1506

COMMON SPEECH – A POETIC EFFECT FOR HOPKINS, BROWNING AND ARNOLD

(Publication No. 16,122)

Richard Lloyd-Jones, Ph.D.
State University of Iowa, 1956

Chairman: Professor Joseph E. Baker

In each generation, poetry, because it is fashioned from language, is revivified by the rhythms and diction of common speech. Poets both before and after Wordsworth have turned to the language as it is spoken and then "heightened" it into poetry. Hopkins, Browning, and Arnold – quite differing poets of the Victorian period – each sought to accentuate the effect of speech as a dominant manner of his poetry.

Of the three Hopkins is the theorist of techniques. He explicitly demanded that the rhythms of speech be the dominant rhythms of poetry and insisted that if the diction of speech is stronger than the diction of conventional verse, then the diction of speech should be used. In practice, his diction is occasionally idiosyncratic, but it is always flavored with the speech of the uncommon man. His rhythms, perhaps overburdened with the chiming melodies of lettering devices, are complex variations of both accentual and syllabic verse, and do approximate the "changes" of speech rhythms.

Browning, who hardly mentions technique, created the effect of speech by depending mainly upon the force of a dramatic situation far stronger than that implied in all poetry. The dramatic point of view is reinforced by the use of sharp vivid images, added one to another more by association than logic. Browning's rhythms, although accentually musical, are freely varied according to the demands of syntax.

Arnold's verse seems to be more conventional than it is. The lines can be scanned according to conventional patterns and the masculine rhymes, rarely softened by internal assonance, alliteration, or rhyme, often mark the ends of lines. Yet, the rhymes frequently are lightly stressed, and the conventional metrical pattern is lost beneath a more significant pattern of syntax, which by means of pauses and subtle groups of sounds establishes a quiet rhythm of speech. Arnold's images likewise stand without adornment in the manner of a restrained, somewhat philosophical observer.

The effect created by the use of various techniques by these three poets is that of common speech. To describe poetry in terms of a single common effect is important because it forces the critic to see the whole poem as a product of the techniques rather than as an example of a single technique. Synthesis as well as analysis is important in understanding a poem. The examination of effect, however, is much limited by the lack of a standard work on poetics. Although many works on poetics exist, these do not serve adequately a person who seeks to examine a result of prosody rather than a system of prosody. Too often prosodists understand only their own system or merely ignore the work of others. Despite this lack of a critical reference point, the use of imprecise but conventional terms can still aid the critic in examining the interrelationships of the many techniques which poets use in creating poems. 178 pages. $2.23. Mic 56-1507

JOHN WESLEY'S TECHNIQUES IN REVISING LITERARY MASTERPIECES FOR HIS METHODIST AUDIENCE, WITH SPECIAL REFERENCE TO PARADISE LOST

(Publication No. 16,340)

Sven Eric Molin, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Arthur Hawley Scouten

The Problem: Assuming that revision of someone else's writing implies a criticism of that writing, this dissertation investigates the relationship between John Wesley's very numerous redactions and the original works from the tradition he was interested in preserving.

Procedure: The extent of Wesley's original publications, his redactions, and his reading range is surveyed in order to determine his literary interests and aims as well as the actual books he revised. Since his working methods were generally constant, two alterations in which he used unusual methods are examined to see whether those methods produced eccentric results. The relationship between his techniques and his announced aims is discussed. Wesley's Extract from Milton's Paradise Lost is taken to be typical of his methods; it is compared in detail with the original poem, with other eighteenth-century editions and criticisms of Paradise Lost, and with Wesley's other writings.

Results: Approximately one-third of Wesley's total published titles, comprising well over one-half of his published bulk, are adaptions. He tended to adapt everything

he read. All his publication is didactic in purpose. His techniques were usually the same: He deleted passages, he annotated, and he starred "excellent" passages. The three techniques may counteract one another: Deletion laconically abbreviates, annotation interpretively expands, and starring laconically expands. His occasional complete re-writings (for example, of George Herbert's poetry and Dr. Johnson's Taxation No Tyranny) are unique in method only. His revisions tended always towards simplification, clarification, and dogmatic generalization. By cutting twenty percent of Paradise Lost, annotating it, and starring approximately one-third of it, he simplified it to be an anti- and unintellectual, Arminian Christian poem, incomparable to pagan epic, and "Methodist" in its emphasis on sin, repentance, and Christ's mercy. Thus his redaction clarified and dogmatized the original poem by solving many problems it raises.

Conclusions: For Wesley, the literary tradition was the conservative neo-classical "orthodox" tradition of Addison and Dr. Johnson; the religious tradition was Anglican. Wesley was conventional in his choice of subjects and his attitudes towards them; his revision of Paradise Lost, for example, is directly comparable to Addison's and Dr. Johnson's remarks on that poem as well as to other eighteenth-century editions of it, such as Bentley's. Wesley was unique in that he actually revised and in that his revisions distorted the originals to make them "Methodist." Thus, although his tradition was conventional, his individual talent for redaction was unique and disruptive.

334 pages. $4.18. Mic 56-1508

LANGUAGE AND LITERATURE, CLASSICAL

SOCIAL CONTRASTS IN ISLAM AS SEEN IN MUSLIM LITERATURE

(Publication No. 16,316)

James Andrew Bellamy, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Franz Rosenthal

This dissertation discusses the social contrasts that existed in Medieval Muslim society between the rich and the poor and the practitioners of various crafts and professions. It is mainly a literary study and utilizes as source material adab-works, the Qur'ān, prophetic traditions, and religious treatises, together with some biographical, historical, and specialized works. The subject matter is treated in roughly chronological fashion.

In pre-Islamic society the prevailing idea was that wealth was a good thing. The poor man was condemned for his rags and hunger and for his inability to entertain guests, while the generous rich man was praised as a pillar of society. This attitude persisted into later times, but it was eventually almost supplanted by the ideal of asceticism.

Muḥammad put the relations between rich and poor on a different footing. He made the old Arab virtue of generosity into a religious duty and gave the poor a vested interest in a portion of the wealth of the rich. Muḥammad did not find fault with wealth itself; his strictures against the rich were because of their refusal to pay the charity tax and believe in his message.

Later on, however, when the ideal of asceticism grew up in Islam, the words and actions of Muḥammad were taken to mean that he favored poverty and despised wealth. Eventually asceticism became so popular that it was used by poets as a literary theme, though the lives of most of them show that they had little interest in practicing it. Hatred of wealth and love of poverty were important features of Sufism, and with the final acceptance of Sufism by orthodox Islam, the victory of poverty was complete. Thus the contrast between rich and poor changed from a socio-economic one, which Muḥammad had tried to mitigate, to a religious one, in which the poor were felt to have the best chance for salvation.

The emphasis on asceticism gave rise to another question – was it right for one to work to gain a livelihood, or should one let God provide? Practical considerations answered this question for most people, as the great number of occupations practiced by Muslims shows.

Here also, however, social differences can be seen. Craftsmen formed the largest occupational group, which appears to be the one most looked down on and discriminated against. Likewise the character of the merchant — an important figure in Muslim society — was often disparaged. In spite of this, however, both merchants and craftsmen entered into religious activities, especially the transmission of religious traditions, and together the two groups gave a marked urban, middle-class stamp to Medieval Islam.

The highest degree of public respect was enjoyed by the religious scholars and teachers. This was the result of the character of Islam, under which most human activity is subsumed.

The lives of poets and secretaries show best how little effect the accepted ideal of poverty had on the people at large.

It seems that the most respected occupations were the ones that were the best paid or that were connected with religion. Thus the most important social contrast was based on wealth. However, no insurmountable barriers existed between the classes. Many examples of "self-made men" show that persons with luck and ability could rise to positions of wealth and power. The love of poverty, though accepted as an ideal by most, was practiced by only a few. Its main effect on Islamic society may have been the prevention of class conflict, such as the West has experienced, and the spiritual stability engendered by it may make the way smoother for those reforms of which Muslim countries today are so much in need.

233 pages. $2.91. Mic 56-1509

LANGUAGE AND LITERATURE, LINGUISTICS

THE LEXICAL RELATION BETWEEN UGARITIC AND ARABIC

(Publication No. 10,828)

Izz-Al-Din Al-Yasin, Ph.D.
Princeton University, 1950

This thesis represents the first comprehensive attempt to compare Ugaritic and Arabic critically and exhaustively. Only one article appeared in Ignace Goldziher Memorial Volume I, (Budapest: 1948), by Joseph Aistleitner, to whose views, conclusions and contributions reference was made and certain corrections suggested.

The author has scrutinized all hitherto published Ugaritic texts, sifted all important words and many morphemes and listed and classified all those that have Arabic cognates. Through the material thus assembled and studied, he was able to demonstrate for the first time that the classical Arabic of the 7th century A. D. has more cognates to Ugaritic of the 15th century B. C. than has the Hebrew of the Old Testament whose earliest records were composed in the succeeding centuries, i.e., from the 13th century B. C. on.

The evidence assembled has forced the writer to discard the view generally accepted among Semitists that Ugaritic is a branch of the Canaanite family. This statement has been proved to be no less erroneous than other statements held by some scholars that Ugaritic is a branch of North, or even South, Arabic.

This comparative study has shown that in conservatism and proximity to the primitive Semitic phonemes, Ugaritic comes only next to Arabic and is therefore nearest to it, in that regard, among all the other sister tongues.

The cognates have been used to establish the Ugaritic and Arabic reflexes of all the Semitic phonemes with frequent reference to the other ancient Semitic languages. More than six hundred Arabic congates have been discovered, many of which will remove the obscurity or uncertainty, concerning scores of Ugaritic texts. Obscurities which had so far blocked the understanding of many expressions in Ugaritic have been clarified by the Arabic etymologies of many words. Thus considerable number of erroneous translations are now corrected; while others, whose validity had been questioned, are not corroborated. Moreover, several mistakes in Arabic and Ugaritic lexicography have been rectified.

137 pages. $1.71. Mic 56-1510

THE INFLUENCE OF THE TEACHING OF ELOCUTION ON MODERN ENGLISH PRONUNCIATION

(Publication No. 16,367)

Jayne Crane Harder, Ph.D.
The University of Florida, 1956

Prominent among the many people who have attempted to prescribe how English should be pronounced were the elocutionists. The problem of this study has been to determine to what extent elocutionary teachings have influenced spoken Modern English, especially American English. The study proceeds chronologically from the sixteenth century to the twentieth, with greatest emphasis falling on the eighteenth and nineteenth centuries. An effort has been made to delineate the elocutionary movement, to establish its origin, nature, and development. Following this background discussion the centuries have been retraced to examine developments in pronunciation.

Sixteenth- and seventeenth-century antecedents of the elocutionary movement are discovered to be the studies of rhetoric, grammar or orthoepy, and stage speech. During these early centuries the major concern was to establish spelling. Attempts to regulate relations between sound and symbol resulted in the prescription of some spelling-pronunciations. Also, a definite concept of a standard English emerged.

The eighteenth century has been discussed in two parts. During the first half of this period the grammarians diligently attempted to regularize all aspects of a language which seemed to them untidy. The problem of orthography, though somewhat diminished, was still of primary interest. Confusion of sound and symbol still existed, and the orthoepists tried to establish methods for teaching spelling by analyzing pronunciation. Early in the eighteenth century the theater achieved new prominence; actors' speech was discussed and described. The latter half of this century provided the real beginning of the modern elocutionary movement with the activities of Thomas Sheridan and John Walker. These two important figures, moreover, provide a link between elocution and lexicography, for between them they originated the system of modern pronouncing dictionaries.

The study of elocution reached its peak of popularity in nineteenth-century America. The activities of both actors and preachers encouraged great interest in the subject, but it was the preachers who led the way. In both England and America the clergy were the first to take over the teaching of elocution. In America instruction in elocution was given impetus and new direction by the writings of James Rush, a medical doctor who set out to make a new analysis of speech sounds. The result, although actually incompatible with Rush's philosophy, was the ultimate development of detailed exercises for meticulous production of all speech sounds. Elocution teachers dwelt largely on articulation leaving other matters of pronunciation to be settled by the authority of dictionaries. Many of the exercises developed for special courses in elocution found their way into classrooms where spelling and reading were taught.

Although elocution as a special study dwindled in stature early in the twentieth century, the tenacity of the enunciation practice developed by elocution teachers can be easily demonstrated. Textbooks continue to suggest practice on articulation exercises recommended a century ago. Correspondence courses offer the same material to people whose schoolroom days are past. Lists of "common words frequently mispronounced" remain popular. Once the concept of standard English was established and teachers dedicated to the legislation of the rules bounding it became entrenched, speakers of English have not lacked copious material for the "improvement" of their pronunciation.

Results of a study of this kind cannot be tabulated into a statistical summary, but an appended glossary, which

compares recommended pronunciations with actual usage, supplies convincing evidence that the elocutionists' influence on everyday spoken English has been slight. Yet the notions that many speakers of American English entertain today about "good" pronunciation are strongly reminiscent of the contents of out-of-date elocution textbooks. People expect to hear meticulously articulated English even though they do not often speak it.

192 pages. $2.40. Mic 56-1511

THE SURNAMES OF TRANS-ALLEGHENY VIRGINIA: 1750-1800

(Publication No. 15,863)

William Emmett Morgan Mockler, Ph.D.
The Ohio State University, 1955

The present work was primarily projected as an etymological and phonological investigation of the surnames in use on America's first English-speaking trans-Appalachian frontier. The endeavor was made to bring under scrutiny all surnames and surname derivatives found in northwestern Virginia before the close of the Revolution, to examine scientifically their constituent elements, and to observe their metamorphosis over a period of fifty years. A secondary object was the elucidation of ethnographical, sociological, and linguistic problems that arose during the course of the investigation. Official public records were the principal surname sources.

The dissertation has two parts. Part One comprises nine sections. Section I outlines the aim and scope of the inquiry. Section II assesses the value of surname study and describes its relationship to place-name endeavor. Section III is an analysis of early Virginia surnames with regard to both origins and forms. Section IV treats phonetic variations. Section V considers lexicographical and vocabular significances. Section VI presents evidences of taboos in the use of certain names and gives reasons for name change. Section VII deals with the contribution of surnames to frontier-place nomenclature. Section VIII traces the development of middle names. Section IX gives an account of documentary materials used in the survey.

Part Two of the study is a dictionary of the surnames in use in early trans-Allegheny Virginia. Here etymologies are given, and names are classified according to national and regional origin and according to type (patronymic, local, occupational, descriptive). One of the primary functions of the dictionary is to present documentary materials for adducing earliest forms of the names. After each instance reference is made to the source.

The chief contribution of this dissertation is one of etymological and phonological detail. An onomasticon of surnames recorded at a time when the English language in America was adapting itself to a new environment throws light upon names themselves, but it also reflects patterns of development in the language generally. It is hoped that the present study will serve as only a beginning in a hitherto unworked field.

305 pages. $3.81. Mic 56-1512

LANGUAGE AND LITERATURE, MODERN

MAN AS ALIEN: THE ISOLATION THEME IN THOMAS HARDY

(Publication No. 15,809)

Samuel Irving Bellman, Ph.D.
The Ohio State University, 1955

Thomas Hardy, like a number of his literary contemporaries, was concerned with the isolation of man from society, one of the results of the sweeping changes which affected the social, religious, economic, political, and intellectual areas of life in nineteenth-century England. The dissertation studies Hardy's handling of the theme of social isolation, examining twelve particularly isolated characters: Clym Yeobright and Eustacia Vye in The Return of the Native; William Dare in A Laodicean; Michael Henchard in The Mayor of Casterbridge; Sophy Twycott in "The Son's Veto"; Jude Fawley, Sue Bridehead, and Father Time in Jude the Obscure; Mrs. Chundle in "Old Mrs. Chundle"; Timothy Summers in "The Three Strangers"; Tess Durbeyfield in Tess of the D'Urbervilles; and Jocelyn Pierston in The Well-Beloved.

In order to examine what happens to these figures it is desirable to disagree with the innumerable commentators on Hardy who have taken literally — despite the caveats in Hardy's official biography (written mostly by Hardy himself) — his comments on Fate, Chance, society, heredity, etc., and have interpreted his fiction in terms of a series of contests between man and external (or internal) forces. A more accurate reading of Hardy may be obtained by applying here the "field" theory of contemporary social psychology, which sees the individual and his environment merging in a (hypothetical) area composed of those elements of each which interact. According to this method of study, neither the individual nor his environment can be adequately understood without emphasizing the "field" which indicates the nature and degree of interaction.

The Hardy fiction works in our group reveal the following pattern, expressed in "field" terms which I have formulated freely from the original suggestions of the social psychologists: the individual is isolated because he does not merge extensively with his environment, i.e., a small amount of his total personality interacts, in the "field," with only a few people of all of those surrounding him, and even then the interaction is on a superficial level. The twelve characters fall into two groups, six being superfluous to those around them (Clym, Dare, Henchard, Sophy, Jude, and Father Time) and six unrealistic about something important in their environments (Eustacia, Mrs. Chundle, Timothy, Tess, Sue, and Jocelyn). The isolated individual, superfluous or unrealistic, encounters two specific kinds of influences in his environment, one having a harmful effect on him, retarding "merging" — the "destroyer" — and one having a beneficial effect, enhancing "merging" — the "redeemer." Depending on how closely the individual comes in contact with these two, and at what point in his life, he will either merge more extensively with his environment (i.e., alleviate his condition of isolation) or he will merge less extensively.

The conclusion appears warranted that the isolate's trouble is due to his experiencing difficulties in his attempts to communicate, either because he is on a different level (morally or psychologically) from that of the

"redeemer," or because another person is interfering with the communication. Paradoxically, the stories of the twelve isolates show that the more one-sided or the lower the degree of communication between the individual and his "redeemer," the less chance there is for a misunderstanding to arise or an outside agent to interfere.

The "field" analyses of Hardy's isolated characters have traced alienation from society to faulty interpersonal relationships, not to the workings of an anthropomorphized force like Fate. Hardy, like some of his literary contemporaries, appears to have reflected not so much the upheavals of the times as the position of the preoccupied and aloof philosopher of life for whom there was no clearly defined role in the nineteenth century so long as he devoted himself primarily to a highly abstracted mode of thought. A statement of Hardy's hints at the faulty kind of "merging" taking place between his isolated characters (perhaps even himself) and the particular environment: "The highest flights of the pen are mostly the excursions and revelations of souls unreconciled to life."

299 pages. $3.74. Mic 56-1513

MELVILLE'S HUMANITARIAN THOUGHT: A STUDY IN MORAL IDEALISM

(Publication No. 16,143)

John Frederic Bennett, Ph.D.
The University of Wisconsin, 1956

This study of Herman Melville attempts to show that a vital pattern of humanitarian idealism sinews the thought-structure of his major works from Typee (1846) to Billy Budd (1891). A tough-minded man, Melville was neither sentimentalist nor optimist; he subscribed to no facile cures for the endless inhumanity of man to man; he saw clearly that human brutality (whatever its degree) extended beyond mortal institutions to find ambiguous source or parallel in a seemingly mindless, brutal universe. Hence, he was not a practical humanitarian, not a reformer in the accepted sense. But the primary mark of his moral character was his humanity. He possessed an invincible belief in the humane truths of compassion, justice, and brotherhood, and he held to that belief during his long and sometimes desperate assault upon the moral inadequacy and inhumanity of nineteenth-century civilization. These same truths of compassion, justice, and brotherhood constitute the fundamental ethical postulates of humanitarian idealism. Therefore, although his critical intellect scorned the fatuousness of much of the professional humanitarianism of his time, Melville was himself a humanitarian idealist whose unsentimental compassion, whose love of justice, and whose faith in the brotherhood of man underpinned in book after book the moral speculation woven into the mythic, symbolic, and anagogic levels of the narrative structure.

Thus, from the outset of his career, Melville's humanity led him to assail the moral failures of a civilization which largely ignored the uses of humane morality. In its general scope and form, his indictment of contemporary society occurs in Typee, Omoo, Mardi, Redburn, and White-Jacket, books which are filled with his angry attacks upon the inhumanities of war, slavery, religious and racial bigotry, political tyranny, economic and social injustice, white imperialism, revolution, and a host of lesser evils. When he finished writing White-Jacket, his affirmation of humanitarian values had taken a direction that it never lost. In the books preceding Moby-Dick, Melville had discovered that to affirm the brotherhood of man was automatically to affirm the heart's democracy and the transcendent dignity and worth of the human spirit. In Moby-Dick, which he wrote in a spirit of "ruthless democracy," Melville brought his humanity to its highest expression. For although it contains much more than can be indicated here, Moby-Dick holds within its levels of myth and allegory Melville's final, irrevocable acceptance of both the liberalizing fact of brotherhood and the corollary moral concepts that stem from it. Ruling much of the speculation concerning the nature of man and society that informs this book and those which succeed it, these corollaries are as follows: that all men are part of an interlinked humanity which it is death to desert; that this interlinked humanity represents a created good which reciprocally sustains and is sustained by the individual; that by virtue of his human identification, each man owes a vital debt of moral responsibility to his fellows; that the mortal interdebtedness of men becomes endlessly a source of spiritual freedom; and that the signal mark of man which distinguishes him from the mindless, demonic universe is his supreme ability to practice the virtues of love and compassion, to prize justice, and to comprehend that the brotherhood of humanity proves the fatherhood of God. In the years and books that followed Moby-Dick, Melville never surrendered his humanitarian belief in the virtues of love and compassion and justice or in the dignity of the human spirit. No matter how deeply he tasted of despair, it was always his humanity which made his despair meaningful.

583 pages. $7.29. Mic 56-1514

MONTEIRO LOBATO: A CRITIQUE

(Publication No. 16,150)

Timothy Brown, Jr., Ph.D.
The University of Wisconsin, 1955

Supervisor: Professor Lloyd A. Kasten

This critical study of the writings of Monteiro Lobato has the purpose of evaluating his achievement in the field of literature for adults.

A biographical study has been made, which combines material from Lobato's own writings, existing studies by others, and data and information supplied by Lobato's friend, the critic Edgard Cavalheiro. The biography aids in putting Lobato's writing in perspective as one of his many occupations, and in showing to some degree the effect of his life on his literature and vice versa.

Regionalism is studied as it appears in Lobato's works, and his contribution in language and subjects is evaluated.

Lobato is discussed as a critic of his country, with his views concerning the various problems on which he wrote. He is an effective writer, with a preference for humor and satire. His essays are readable, forceful, and entertaining, though their literary value is diminished for the most part by their immediate, specific purpose and polemic

tone, the very qualities that made them good instruments of Lobato's campaigns for the improvement of his country.

The standing of Monteiro Lobato as a literary artist must rest upon his short stories, although he wrote one novel. His stories have positive values, uniquely his, that contribute to the strength of his work. Of great importance is his achievement in capturing in his stories the towns, plantations, and human types of the region of the state of São Paulo where he grew up and spent the first half of his life. Also of value is the criticism contained in his treatment of the Brazilian scene, his portrayal not merely of the picturesque, but his judgment of what he sees and records. His humor, satire, and frequent violence give character to his works.

His stories have defects as well as merits. Lobato's insight into human nature is not the most profound. His characters often are not real persons, but rather embodiments of particular traits, frequently exaggerated. He has not always realized the dramatic possibilities of his plots, and at times, through digressions and comments, he strains the illusion of reality in a story.

Although his stories are of uneven quality, some of them, particularly certain humorous tales, rank with the best that have been done of their type, and yet remain for the most part typically Brazilian. His accomplishment in the field of the short story, at its best, stands as a solid achievement, an important development in Brazilian literature. 197 pages. $2.46. Mic 56-1515

THE EMERGENCE OF AMERICAN SCIENCE FICTION: 1880-1915; A STUDY OF THE IMPACT OF SCIENCE UPON AMERICAN ROMANTICISM

(Publication No. 16,318)

Thomas Dean Clareson, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Robert E. Spiller

The purpose of this study has been two-fold; first, to trace the origin and development of American science fiction into a distinctly recognizable, separate genre; and second, to analyze the scientific data used and major themes developed by American writers in order to attempt to discover the reaction of the popular imagination to scientific materials.

Essential to this study has been the definition of science fiction as that continuing genre within the broad scope of fantasy which attempts to present the impact of the mechanistic and allied sciences upon the imagination of man. As such, it reflects directly the thoughts and interests of its period; moreover, as each field of science provides material provocative to the imagination, writers make use of that material. Their basic technique is the extrapolation of a known fact or theory along a possible/probable line of development; that is, given a certain fact, what would happen if. This definition and technique distinguish science fiction as a separate literary form.

Since this has been a study of American contributions to science fiction, not of science fiction in America, only those continental and British writers who have had direct influence upon Americans have been discussed. Although not definitive, this study does include those works which were important because of their dates of publication, those works which established and are representative of the major themes and forms, and those stories which show major deviations from the established themes and forms.

Between 1880 and 1915 each field of science helped to create a type of science fiction:

1.) Psychology transformed both the ghost story and the Poe-Blackwoods' type of story into the study of psychological aberration. This form had perhaps the most difficulty developing because of the threats to the traditional concepts of man implicit in a materialistic psychology. To counteract these threats, much mysticism was included.

2.) Geology, archeology, and the interest in current exploration transformed the "imaginary voyage" into the lost race novel, which concerned itself with the discovery of a fragment of some little-known or prehistoric civilization in an unexplored corner of the world. Thematically, the lost race novel concentrated upon the problem of socialism and the reconciliation of scientific discovery with the Mosaic cosmogony.

3.) Astronomy, particularly the controversy arising from Schiaparelli's discovery of the "canals" of Mars, created the interplanetary travel novel. As its dominant theme, it expressed a belief in Fiske's concept of inevitable, progressive development.

4.) Chemistry, physics, and engineering created the novel in which a scientist in advance of his times invented some wonderful machine. The major theme was the idealization of the scientist.

5.) The interest in invention and in military ordnance created the future war novel, in which an American scientist developed a weapon so terrible that it not only saved the United States from immediate attack, but also brought all war to an end. Thematically, it not only idealized science, but also expressed the idea that America's manifest destiny was to lead the nations of the world to the Utopian millenium.

6.) Because the Utopian romance was so concerned with political issues, science did not receive a primary emphasis in the portrait of future societies until after the turn of the century. Then the Utopian romance expressed the theme, Science plus Socialism equals Utopia.

7.) Near the close of the period there developed that type of novel in which a scientist saved mankind from a catastrophe that threatened to destroy civilization, if not the earth. Thematically, the scientist was hailed as the saviour of society, who would lead mankind to the Utopian millenium.

Thus, by 1915, science had become the tool of romanticism. 365 pages. $4.56. Mic 56-1516

DIE REVISION VON STIFTERS ABDIAS

(Publication No. 15,837)

Paul Gottwald, Ph.D.
The Ohio State University, 1955

One of the most important and challenging questions in the study of literature is the inquiry into the genesis of a work, the attempt to explore the nature of this type of artistic creating.

The special case of a second writing of the same work, the revision of the product by the author, permits an insight into the otherwise almost inaccessible creative process of the poet. In a comparison of the two versions his artistic intentions may be recognized even more clearly, objectively, and in greater detail than from his own comments.

Such an opportunity is provided by Adalbert Stifter's Abdias, which was probably written between 1841 and 1842. The author made an extensive and thorough revision for the first edition of his Studien, probably in the summer of 1846.

Stifter's revising was guided by newly acquired principles of art whose general tendencies become evident in his letters. These principles have been treated by many literary historians. Since the purpose was to examine them in their application and effects during the process of composition, it was necessary to search for the patterns which gave consistency to the changes. From these, categories could be established according to which the changes were organized. To avoid the danger of coining categories through prejudice or precipitous impressions (instead of allowing them to form naturally), physical maneuverability for words and passages concerned was highly desirable; this was attained by the following means: the two texts — with the exception of the few unchanged passages — were copied and so arranged in two columns that, as far as possible, corresponding locations or empty spaces were matched. Where the author had rearranged passages, cross references were used. This arrangement permitted the recording on cards of: (a) shortened passages of the first version, with indication of excised words; (b) additions in passages of the second version. For the purely qualitative alterations such cataloguing proved impractical, necessitating direct reading from the two-column copy. Thus the locations could be isolated and tentatively grouped along various theoretical lines until those cases could be viewed together which are related in form or idea and from which the reasons for the revisions could be comprehended.

We find, especially, changes striving for more plastic impressions of characters, places, and events. Stifter achieved this in the following way: in place of brief statements he frequently supplied detailed, step-by-step descriptions of occurrences. Static description was sometimes made vivid by casting it in the form of action. Abstractions were often replaced by something visible. Concrete and specific terms were often substituted for broad and general concepts. In his descriptions the author strove for elementary simplicity and epic completeness. He desired objectivity and neutrality. Thus the number of narrator's comments was greatly reduced, and subjective or evaluative expressions were avoided. Statements of the thoughts and emotions of the characters became rare, either through elimination or by making them evident from external action. Many metaphors were sacrificed.

The style of the second version is temperate and, except for a few places, free from the extravagances of the first. Rejecting sensationalism and stereotypes, this style reveals strict discipline concentrated upon simplicity. Semantic and stylistic carelessness is corrected. A not inconsiderable number of changes introduce elements which in their contexts sound more appropriate, pregnant, or convincing.

The detailed comparison reveals that Stifter created the second version with the old text constantly before him, weighing and evaluating word for word and sentence by sentence. It also becomes evident that at this stage in his development Stifter had already conceived it as his task to convey verisimilitude through sober and exact delineation of the observable. 259 pages. $3.24. Mic 56-1517

LE STYLE DE MONTAIGNE

(Publication No. 16,166)

Floyd Francis Gray, Ph.D.
The University of Wisconsin, 1955

Supervisor: Associate Professor Alfred Glauser

There is no doubt in the minds of critics that Montaigne's style is one of the most significant in French literature; yet no thorough study of it has ever been made. There are several reasons for this, of which perhaps the most important is that Montaigne's style is consubstantial with its author, presents no contradiction between language and thought, does not afford to the critic's eye that useful contrast which such a distinction produces in Guez de Balzac or Flaubert.

Montaigne is diametrically opposed to those writers who concern themselves more with words than with the thought that these words are supposed to convey, to any style that implies a dichotomy between the conception and the expression of an idea. Since he avoids the formal sophistications of the professional artist, his essential naïveté, interior form, and organic reality are faithfully indicated in the very words that are used to describe them. Montaigne himself calls the Essais a "skeleton," and its different anatomical parts identify themselves closely with the different parts of speech which compose it. In this thesis, the sentence, the vocabulary, the adjective, the adverb, the verb, the substantive, the conjunction, the preposition are analysed, not only as syntactical phenomena having special grammatical functions, but as inherent parts of an organic structure.

This stylistic body has quite naturally its tempo, that is to say, its particular speed of progression. Only the prose of Marcel Proust has an equivalent slowness, one which is due not only to sentence structure, but also to the temperament of the artist, to the disinterestedness and gratuity with which he writes.

The composition of the individual essais is either exterior or interior. Any evolution that can be perceived in the passage from the earlier to the later ones was provoked less perhaps by the successive influence of Stoics, Pyrrhonists, Epicureans than by the development and transformation of the artist by his work. In the earlier essais there is a kind of exterior logic, but the more closely Montaigne studies himself, the more interior and the less rationally logical his composition becomes. The interior order follows a line that reveals itself and which can be traced in the images that it deposits. These families of images provide a kind of subterranean order, one that originates in the very material which is used to constitute it rather than one artificially imposed from the outside and to which this material must conform.

Since Montaigne composes as he writes, his style is supremely lyrical, and I have attempted to identify and explain some of its poetic elements, such as alliteration and assonance, literary comparison, and above all, the image. Here I have utilized the extensive unpublished notes of Albert Thibaudet which are found in the library of M. Jean Paulhan. I have tried to show that Montaigne's true message and philosophy manifest themselves in his images. These images fall into several natural and closely related groups, but are primarily images of movement. One of their most essential characteristics is that of fluid suppleness. They glide frequently from one category to another, expand, like a plant, following the direction of their growth.

Montaigne's style has had no direct progeny, but its presence is felt in a certain opposition of the relative to the absolute, of the discontinuous to the continuous, of nature to art. Because he refused to admit a style that would conceal or adorn him like a ready-made cloak, and seeks one that can be applied tightly to his interior form, the real Montaigne, his actual essence, can be discovered only in the body of his style. 376 pages. $4.70. Mic 56-1518

THE LITERATURE OF PRAISE: A STUDY IN RENAISSANCE AESTHETICS

(Publication No. 16,169)

Osborne Bennett Hardison, Jr., Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Ruth Wallerstein

This dissertation is a critical analysis of the idea of praise in Renaissance literature and literary criticism. It demonstrates and evaluates the influence of the theory of praise on occasional literature and the non-occasional genres of epic, drama, and lyric.

Chapter I investigates the ways in which the epideictic label – used by rhetoricians to designate the oratory of praise and blame – is applied to literature. There were three common positions. First, the "oratorical" position holds that the epideictic label applies not only to a type of oratory, but also to all creative literature. In this sense, drama, epic, and lyric are merely special cases of the epideictic branch. The second, or "literary" position is that the epideictic label designates those compositions which would today be called occasional – funeral elegy, epithalamium, encomium, etc. The third, or "rhetorical" position holds that the epideictic label designates a technique rather than a series of poetic types and is used to produce "set pieces" or to "amplify" sections of longer works.

Chapter II discusses the chief meanings associated with the term, epideictic. First, epideictic literature was never seen as sheer flattery, but as incitement to virtue through examples worthy of emulation. Second, ideas associated with the epideictic were used to answer attacks on literature, and as a result, the epideictic was made broad enough to include non-occasional forms. The attack on literature as a series of lies was easily met since epideictic literature is based on history. The attack on literature as hedonism was met because epideictic literature creates moral exemplars. This defense justifies the application of the epideictic label to fiction. Finally, the attack on literature as thrice-removed imitation was met by the claim that, in treating the moral aspects of events, the writer treats their idea rather than their often disillusioning reality. In that the poet delights while teaching, he surpasses the severe philosopher.

Chapter III examines the non-occasional genres of epic, drama, and lyric, showing how epideictic ideas affect the theory of each type and how a right appreciation of this allows us to recover the typical Renaissance heirarchy of poetic genres.

Chapter IV moves from non-occasional to occasional forms. Funeral elegy is selected for detailed treatment, and the rhetorical prescriptions for its topics and patterns are discussed. Chapter V then examines several representative funeral elegies, demonstrating the persistence and flexibility of the patterns discussed in Chapter IV.

Chapter VI attempts to modify previous emphasis on theory by a complete analysis of Donne's Anniversaries. Here the theory of praise is basic, but there is a conscious effort to see praise in its proper relationship to other elements.

The conclusions of the dissertation are that the idea of praise is all-pervasive in the Renaissance and profoundly affects Renaissance theories of occasional and non-occasional genres. It is also extremely influential on poetic practice, and much Renaissance literature cannot be appreciated without a right understanding of this fact.

449 pages. $5.61. Mic 56-1519

GERHART HAUPTMANN'S FICTION: A STUDY OF AUTOBIOGRAPHICAL MOTIFS

(Publication No. 15,496)

Carl Keul, Ph.D.
Cornell University, 1955

It is widely recognized that Gerhart Hauptmann's work contains much that is autobiographical. The purpose of this study is threefold: to examine the poet's autobiographical writings with the view to establishing the presence of certain central themes in his life; to consider his narrative fiction with the purpose of determining the significance of these factors in his works; and to attempt to show, with regard to these themes, the degree to which the poet tends to use them, with little or no alteration.

Five themes representing both realistic tendencies and irrational resources are recognized in his life and works: Social Consciousness, Religion, Eros, Daemon, and Individualism.

Hauptmann's social consciousness is most evident in his earlier works and is manifested in his tendency to depict with great sympathy the plight of the poor, and at the same time, to portray the upper classes in a less favorable light. Later works reveal generally a change in attitude on the part of the poet. The elder Hauptmann seems no longer to be the champion of the poor; he resigns himself philosophically to a world which the younger Hauptmann sought to reform.

The poet's religion consisted in a satisfactory balance between two polar concepts: certain Christian values gleaned primarily from an objective study of the life of

Christ, and a pagan, polytheistic view of the deity. In his works doctrinary Christianity, and especially Catholicism, is a chief target for Hauptmann's criticism and satire. Eros and other aspects of nature, reflected as religious principles in his works, are usually victorious over Christianity.

Extremely broad is Hauptmann's conception of Eros, permitting in its various connotations inclusion of all those forces which represent fertility in nature, and the creative powers in man from which all culture springs. Concerned primarily with the relationship between man and woman, this aspect of the study reveals that although Hauptmann frequently depicts promiscuity and licentiousness, there is also present in his work an element of the traditionally romantic approach to love. Eros as a religious principle in the poet's work permits man to transcend the narrow confines of human existence.

The daemonic force is regarded by Hauptmann as a dimly defined cosmic regime which disposes with man in arbitrary fashion. Most evident in his works are the daemonic impulses in love relationships, but the daemonic power is no less apparent in natural phenomena, in artistic creativity and in the appeal of certain localities. Any situation which is capable of evoking a strong emotional response has, for the poet, daemonic potential.

Many events of Hauptmann's life reveal a spirit of revolt against the conventions of society, but there are others in which a positive constructive aspect prevails. Some of the poet's characters are strong-willed individualists, but most of them acquire their singularity by virtue of the daemons that impel them, and that may make them appear to be weak. All of them, however, are strongly individualistic, and are portrayed with meticulous care.

Hauptmann's fiction borrows very heavily from personal experience. Certain experiences are used repeatedly and with such identity of detail as to appear almost monotonous. His work seems to offer a series of experimental efforts to present central experiences of his life in new forms and varied contexts.

184 pages. $2.30. Mic 56-1520

THE ART OF JOHN STEINBECK: AN ANALYSIS AND INTERPRETATION OF ITS DEVELOPMENT

(Publication No. 14,769)

Peter Lisca, Ph.D.
The University of Wisconsin, 1955

Supervisor: Professor Frederick J. Hoffman

John Steinbeck is a much better artist than has been generally recognized, deserving a place beside Faulkner and Hemingway as one of the greatest living American writers of fiction. His true position has been obscured for three reasons: The three great novels of the 1930's (In Dubious Battle, Of Mice and Men, and The Grapes of Wrath) still suffer from being too closely associated with the "social protest" writing of that decade, an association which has been extended to his other works; those aspects of Steinbeck's art related to his biological interests have been subjected to a stereotyped interpretation since 1940; most critics have assumed that Steinbeck's art is one of slick surfaces, needing no explication.

The present study takes up each work in its chronological order and by subjecting it to formal and ideological analysis achieves new insights into the complex nature of Steinbeck's work.

Steinbeck's prose style is diverse and it serves as an instrument for evaluating his materials as well as presenting them. The difference in meaning between such superficially similar works as Tortilla Flat and Cannery Row as well as between In Dubious Battle and The Grapes of Wrath lies largely in a prose style which controls the reader's attitude toward the materials presented. This prose style ranges from the paisano mock-heroic tone of Tortilla Flat to the Biblical cadences of The Grapes of Wrath. It is capable of a lyric realism (The Red Pony, Of Mice and Men, The Pearl) and also of an unpoetic naturalism (In Dubious Battle, The Wayward Bus).

Another aspect of Steinbeck's art which is clarified is his objective method of portraying character. He seldom relies on character to establish or illustrate the themes of his fiction. Rather, his characters are conceived as part of a total design to which they are subordinated. All of his successful novels make use of character in this way. Invariably, the weaker Steinbeck novels are a result of either carrying this concept too far (The Moon Is Down, Burning Bright) or of abandoning it in an attempt to establish his theme in terms of character rather than structure and style (Cup of Gold, East of Eden). Only in his short stories has his focus on character been successful.

Steinbeck makes much use of symbolism, not only as a means of wider reference but also as a principle of thematic structure. These typical uses of symbolism are much more obvious in his first two novels than in subsequent works, where they have gone unnoticed because they are so natural to his materials. Consequently, his works often have a deceptive simplicity, as in The Red Pony, Of Mice and Men, and The Wayward Bus.

Despite a lack of attention to individual character, Steinbeck's writings reveal that his sympathy for the poor and the outcast is humane rather than political, and that he places his approval on the free individual rather than the well-fed and well-clothed unit of society. Steinbeck's ability to handle "proletarian" materials without propaganda or sentimentality comes from his awareness of social ecology, his non-teleological thinking, and a concomitant reluctance to assign positive and final blame.

Another of Steinbeck's greatest assets as an artist is his interest in biology, which provides him with a philosophic framework and an objective point of view. This has resulted in a wider and therefore more humane perspective on man, rather than a naturalistic conception of man as animal. In fact, the weakness of Steinbeck's three most recent novels is caused to a large degree by a decline in the intensity of his biological view of man.

419 pages. $5.24. Mic 56-1521

ECHOES OF VIRGIL AND LUCAN IN THE ARAUCANA

(Publication No. 15,243)

James Edward McManamon, Ph.D.
University of Illinois, 1955

This study is related to the problem of sources. We have attempted to show classical influence in a Renaissance epic. Menéndez y Pelayo has expressed a most plausible opinion in his Historia de la poesía hispanoamericana, 1913, tomo II, pp. 295-305 passim, maintaining that Ercilla imitated Virgil and Lucan.

The purpose of the thesis is to clarify in some degree the statements of Menéndez y Pelayo on the relation of the Aeneid and the Pharsalia to the Araucana, to test by concrete and detailed evidence the probability of the Spanish critic's judgment by investigating and exposing the actual similarities that do exist in the topics mentioned by him as imitations of Virgil and Lucan. Our purpose also is to investigate and point out other important similarities which may exist in these epics but which are not specifically mentioned by Menéndez y Pelayo.

We have done this by a detailed comparison of outstanding similarities in these epics. These similarities we have called echoes. For the purpose of this study we define an echo as the repetition of an epic element or a structural element, of similar subject matter and themes plus similar descriptive details, or similar types of details, similar descriptive and narrative techniques, all of which recall readily, now strongly now weakly, a similar treatment in the Aeneid or the Pharsalia.

The method we used was to compose a long list of the principal points of comparison of epics. We then read through the Araucana, the Pharsalia and the Aeneid, making up cards on all the assembled items of comparison of epics. We boiled down and limited our material to our present table of contents. Our criteria for selection were as follows. The similarities must be striking. They must be definite and recall readily similar treatment in the Aeneid and the Pharsalia. If not completely evident or patent on first reading, they must reveal upon study and analysis that they have elements or descriptive details in common, or at least similar types of details. The emphasis in our selection has been on the choice of significant similarities and details. We have divided our study into four divisions: (1) Preliminaries, (2) Bellic Material, (3) Supernatural Element, and (4) Additional Episodes.

Our findings gave ample proof of the correctness of Menéndez y Pelayo's statements about the influence of Virgil in such topics as the games, the storm, the catalogue or review of troops, and about the influence of Lucan in the portrait of Fitón and his pharmacopoeia. In addition to these we found many other echoes of Virgil and Lucan in the Araucana.

The results of our investigation show that the Araucana, in relation to its classical predecessors, is primarily a Virgilian type of epic. It echoes the Aeneid in the large epic and structural elements which contain many and strong echoes of Virgil. Echoes of Lucan consist mainly of echoed details which appear for the most part scattered throughout the Araucana with the exception of the sea battle of Lepanto and the portrait of Fitón and his pharmacopoeia where echoes of the Pharsalia are usually concentrated. Characteristic of the echoes of Lucan is that from a myriad of details used by him to describe a certain subject matter, Ercilla will echo only one to three items, fitting them into his own similar or related subject matter. Characteristic of Ercilla's classical echoes is the mixture of echoes from the Aeneid and the Pharsalia woven into one subject matter in the Araucana, now simply now intricately. Often there is evidence of similar descriptive and narrative technique especially in the Virgilian echoes. For the most part Ercilla echoes his classical predecessors not servilely or consistently but freely and sporadically. The Araucana echoes the Aeneid in its glorification of war and valor and in its idealistic attitude toward fighting and dying on the battlefield. Finally the Araucana echoes very strongly the nationalistic and patriotic theme of the Aeneid. Much as Virgil extols the valor and deeds of both Latins and Trojans who really are the ancestors of the Roman race, so Ercilla extols Spanish and Indian valor on the battlefield and Spain's conquests throughout the world. Ercilla uses several Virgilian techniques to accomplish this nationalistic objective of the poem. Just as the Aeneid is a glorification of the Roman race and of Augustus Caesar, so the Araucana is an apotheosis of Spain and of Philip II.

297 pages. $3.71. Mic 56-1522

OLE EDVART RÖLVAAG: A CRITICAL STUDY OF HIS NORWEGIAN-AMERICAN NOVELS

(Publication No. 15,276)

Robert Lowell Stevens, Ph.D.
University of Illinois, 1955

O. E. Rölvaag's novels of Norwegian immigrant life in America are distinguished by perceptive pictures of life on the frontier, by penetrating character studies, and by a philosophy that was strongly influenced by Ibsen.

Amerika Breve (1912), still untranslated into English, concerns the new immigrant in an established society. The view of life given here is that of an orthodox Christian. Pure Gold (1930), a revision of To Tullinger (1920), is the story of two persons who have been isolated from Norwegian culture and have found no new culture to take its place. In this novel Rölvaag, consciously or unconsciously, drifted toward naturalism. The two principal characters are convincingly drawn. In The Boat of Longing (Norwegian version, 1912; English translation, 1933), which seems an inferior work in spite of certain poetic qualities, Rölvaag, with his distinction between fearless and timid characters, shows Ibsenian influences.

Rölvaag's masterpiece, and the work by which he is principally known, is Giants in the Earth (Norwegian version, 1924-25; English translation, 1927). Here the fearless character is represented by Per Hansa and the timid character by Beret, Rölvaag's two greatest characters. Here Rölvaag seems to be saying that the fearless and the timid find peace and happiness in different things: the timid in conformity, in being led; the fearless, in being leaders. The fearless have learned to reject the lie in order to be able to accept the truth. The noblest purpose in life is self-realization, and the happiest person is one who is occupied with some life purpose, some aim that

inflames his mind. The real joy in life is not in being but in becoming. Morality is not a matter of following rules; what is wrong today may well be right tomorrow.

In Peder Victorious (Norwegian version, 1928; English translation, 1929) and Their Fathers' God (1939), Rölvaag develops the idea that Norwegian immigrants can best contribute to the American democracy by retaining their Norwegian cultural heritage, including the Norwegian language. The alternative is to become thoroughly Americanized – like all other Americans but unable to contribute anything original to the culture.

Artistically Rölvaag's stature continued to grow with each volume of the trilogy, but after Giants in the Earth he never again found the great theme that would allow his artistry its fullest expression.

247 pages. $3.09. Mic 56-1523

MATHEMATICS

NORMAL BASES AND GALOIS THEORY

(Publication No. 16,463)

Carl Clifton Faith, Ph.D.
Purdue University, 1956

Major Professor: Sam Perlis

The first part of this dissertation presents a development of the Galois Theory from a new viewpoint in which the existence of a normal basis is assumed at the outset and the usual notions associated with normal extensions are derived later.

An element is defined to be basic in a normal extension in case it generates a normal basis for the extension. A completely basic element of a normal extension K/F is one which is basic in K over every intermediate field. The existence of a completely basic element for each normal extension over an infinite field is proved. It is shown, however, that not every basic element is completely basic.

A normal extension is called completely basic if every basic element for the extension is completely basic. The existence of a large class of completely basic fields, including all Kummer fields, is demonstrated.

The greater part of this thesis is aimed at the determination of those normal extensions which are completely basic. This determination is achieved for cyclic fields of prime power degree p^e over a field in which the polynomial $x^p - 1$ factors linearly, and in certain other significant cases. 85 pages. $1.06. Mic 56-1524

EXTREME GAMES, SIMPLE GAMES, AND FINITE SOLUTIONS

(Publication No. 16,327)

Herbert Morton Gurk, Ph.D.
University of Pennsylvania, 1956

Supervisor: Harold W. Kuhn

Von Neumann and Morgenstern have asked a number of questions about a special class of games, the simple games, and about a class of "natural solutions" for these games, the main solutions (Theory of Games and Economic Behavior, Princeton University Press, Princeton, 1944, Chapter X). An n-person simple game is a game in which the players can form only two types of coalitions, winning and losing coalitions. Using the (0, 1) normalization (i.e., single player coalitions have value 0, the coalition of all players has value 1), an n-person simple game is defined by a characteristic function v such that $v(S)=0$ or 1 for all coalitions $S \subset (1, \ldots, n)$. Winning coalitions have value 1; losing coalitions have value 0. A main solution for a simple game is a solution $V_U = \{\alpha^S / S \in U\}$ where U is a collection of minimal winning coalitions for the game, and α^S is an imputation such that $\alpha^S_i = x_i$ for $i \in S$ and $\alpha^S_i = 0$ for $i \notin S$ where the x_i are non-negative constants for $i = 1, \ldots, n$. A main simple solution is a main solution V_U such that U contains all the minimal winning coalitions. Since U can contain only a finite number of coalitions, V_U is a finite solution.

The questions asked by von Neumann and Morgenstern were the following:

(1) Does every strong (i.e., constant-sum) simple game have a main solution?

(2) Does there exist a main solution V_U for a simple game in which a contributing player gets no share of the spoils, i.e., for some $S \in U$ and for some $i \in S$, $x_i = 0$?

(3) Does there exist a main solution for a simple game which is not main simple for that game?

This dissertation answers these questions and then extends some of the results and related concepts in order to consider broader areas. The first of the above questions is answered in the negative, and the second and third are answered in the affirmative. Some general properties of simple games and of their main solutions are developed in the process of arriving at the answers to the questions. General questions about finite solutions for simple games are then considered. Non-main finite solutions are exhibited, and a more general definition of a "natural (finite) solution" is given. All exhibited finite solutions of simple games are shown to belong to a class of "naturally-derived" solutions. It is conjectured that all finite solutions of these games fall in this class. Then, it is proved that if the conjecture is true, not every strong simple game need have a finite solution.

The class of simple games is then extended to the larger class of extreme games. Using the (0,1) normalization, an n-person game with characteristic function v is extreme provided there do not exist two different games with characteristic functions v_1 and v_2 such that

$$v(S) = a\, v_1(S) + (1-a)\, v_2(S) \text{ for all } S \subset (1, \ldots, n)$$

where $0<a<1$. It is shown that for $n\geq 5$, the class of extreme, constant-sum, n-person games properly contains the class of n-person, strong simple games. A characterization is given of 5-person, constant-sum, extreme games which enables one to exhibit all such games. A solution is developed for these games which is a generalization of a well known solution for simple games. It is shown that these results do not hold, in general, for extreme games with more players.

72 pages. $1.00. Mic 56-1525

THE DEVELOPMENT AND ORGANIZATION OF TEACHING MATERIALS IN A COLLEGIATE MATHEMATICS PROGRAM FOR STUDENTS OF THE NON-PHYSICAL SCIENCES, PART I

(Publication No. 16,129)

Robert Charles Seber, Ph.D.
State University of Iowa, 1956

Chairman: Professor H. Vernon Price

We consider a mathematics curriculum with respect to (I) topical content, (II) style of presentation, and (III) illustrative material. Attention is called to two types of course sequences built about a fixed core of topics and denoted as "traditional" and "unified." Dissatisfaction with current curricula as curricula for students of non-physical science is related to (I), (II), and (III).

Certain mathematical terms are the referents of terms used in non-physical science. The application of mathematics to these sciences is approached in this sense. This application is considered in two categories: (A) quantitative description in non-physical science and (B) mathematical models to schematize non-physical science phenomena.

A course sequence with a prerequisite of college algebra and trigonometry is proposed and considered relative to (I), (II), and (III). This sequence includes topics of algebra, geometry, analysis, and statistics. The course structure is classified as "unified." The standard core of topics is retained but is not treated extensively. Emphasis is placed on the style of presentation which is for each new topic an "explication" in the sense of Carnap. Topics of statistics and probability are an integral part of the course. Each topic is considered with reference to its descriptive background, formalization as a mathematical system, and application in describing phenomena of non-physical science. Types of illustrative material relative to applications are presented in detail for some topics.

382 pages. $4.78. Mic 56-1526

EXPONENTIAL REGRESSION

(Publication No. 16,500)

Myron J. Willis, Ph.D.
Purdue University, 1956

Major Professor: Carl F. Kossack

The purpose of this study is to review the mathematical and statistical aspects of the exponential regression function

$$y = \alpha_1 e^{\alpha_2 x}.$$

The following topics are considered: (1) historical development of the function, with its early applications as a regression function, (2) the underlying mathematical conditions for the function, (3) methods of testing the appropriateness of the function as a regression model, (4) methods of fitting the function to a set of observations, (5) distributions of the parameter estimators, (6) tests of significance of differences between estimates of parameters from two samples, (7) confidence regions for predicted values of y.

Two regression models are considered in detail. These are:

$$(1)\quad y = \alpha_1 e^{\alpha_2 x}\,\delta$$

where the logarithms of δ are normally distributed, and

$$(2)\quad y = \alpha_1 e^{\alpha_2 x} + \delta$$

where δ is normally distributed. Appropriate methods of fitting these models are given. A complete analysis with distributions of parameter estimators, tests of significance, and confidence limits for predictions are given for the first model. The second model yields only partially complete analysis, with asymptotic distributions for the estimators.

Several systematic methods of fitting the exponential function are exhibited in detail. These include: (1) maximum likelihood, (2) the method of least squares, (3) the Taylor series approximation to the method of least squares, (4) a difference equation method, and (5) Hartley's method of "internal least squares." Examples are given for each method. In addition to the systematic methods, several "inspirational methods" are outlined, including (a) the method of visual comparison, (b) the method of averages, (c) the freehand curve method, and (d) the method of isolated points.

A special case of the method of isolated points is examined in detail to obtain information on the magnitude of the problem of working out complete analyses for inspirational methods of fitting the exponential function. Distributions of the estimators are determined for the special case of the uniform error distribution. Conclusions drawn are that although exact parameter distributions can be determined under certain simplified conditions, the problem of working out solutions generally would involve far more labor than should be expended for inspirational methods.

Empirical methods are suggested as a means of studying the problem of asymptotic convergence to normality of the distributions of estimators in the case of the additive error model. Such approaches may lead to results that are useful for small samples.

117 pages. $1.46. Mic 56-1527

THE STRING FANTASIES OF JOHN HINGESTON (c. 1610-1683) (VOLUMES I AND II)

(Publication No. 16,106)

Emil William Bock, Ph.D.
State University of Iowa, 1956

Chairman: Professor Albert T. Luper

John Hingeston (c. 1610-1683) was one of many prominent composers who contributed substantially to the musical life of seventeenth-century England. Although professionally, as a musician under Charles I and Cromwell, he was designated keeper and repairer of organs, his most lasting contribution to music is his seventy-seven string fantasies.

Hingeston's position in the musical life of England was unique, for he was one of the few musicians who were equally successful in serving, with considerable distinction, both the Royalist and the Puritan regimes. While in the service of Cromwell, he was given the distinction of being appointed chief musician. Although his position was not so exalted during the Restoration, he was considered one of a half-dozen of the most valuable and highly paid men in the service of the King.

The periods of the Commonwealth and Restoration were years of transition in the history of England. Events moved swiftly, with changes in the political, social, religious, and economic life of the island, reflecting an instability that was not resolved until the beginning of the eighteenth century. Styles in music may be said to have followed a similar pattern. This transitionary period of musical composition is particularly reflected in the work of Hingeston and of such of his illustrious compatriots as John Jenkins, Matthew Locke, Christopher Simpson, and William Lawes. All of these musicians were men of the older generation, whose compositions were founded upon the musical style of the Elizabethan Era. Nevertheless, the new influence of the Italian Baroque is plainly visible in the works of these composers.

This study of John Hingeston comprises two volumes. The first contains a commentary on the musical and social life of the times, a biographical account of Hingeston, a description of his manuscripts, and a stylistic analysis of his fantasies. The second volume contains twenty-four fantasies, chosen from the seventy-seven which were transcribed from microfilm copies of British Museum MS. Add. 31436 and MSS. D205-211 of the Bodleian Library, the latter originally part of the collection of the Music School at Oxford.

An examination of Hingeston's fantasies has revealed him to be an excellent composer, quite comparable in craftsmanship and expressive powers to some of his more illustrious contemporaries. Although his compositions show him to be, basically, a conservative, he was one of the few of the older generation who readily accepted the new Italian concertante style and aided in the process of breaking away from the Renaissance style so firmly entrenched in England during his lifetime.

None of his manuscripts bear any dates, but upon a basis of a few threads of evidence and analysis of his works as compared to those of his contemporaries, it can be said that his first compositions were written sometime before 1640 and his later compositions after 1660. His first works reflect the style of his probable teacher, Orlando Gibbons. His later compositions indicate that he may have been the first in England to use violins in his three-part fantasies, and one of the first to employ a basso continuo instead of the usual, written-out, organ accompaniment that doubled the string parts. All the works, whether early or late, manifest a high standard of artistic skill in musical composition, particularly with regard to contrapuntal techniques.

Scholars who have made preliminary and general studies of this period of England's musical history have already indicated the high merit of the work of some of the more famous composers. This study has revealed a composer who, although forgotten, compares favorably with Jenkins, Locke, and Lawes. 551 pages. $6.89. Mic 56-1528

TONAL MOVEMENT IN THE POLYPHONIC BALLADES, RONDEAUX, AND VIRELAIS OF GUILLAUME DE MACHAUT

(Publication No. 16,440)

Robert Arthur Wykes, D.M.A.
University of Illinois, 1956

The purpose of this study is to determine what principles of tonal movement are operative in the music of Guillaume de Machaut (130?-1377). This particular aspect of Machaut's music has not been the major concern of previous writers. In view of the limited scope of this study, it was felt more profitable to concentrate on a segment of Machaut's work, the polyphonic Ballades, Rondeaux, and Virelais, rather than to deal with the whole body in a manner that would have necessarily been more superficial.

The method of analysis that is employed throughout the study makes a basic distinction between "structure" and "prolongation" in music. This concept of musical analysis was first exploited by Heinrich Schenker (1868-1935) in his studies of music from the period Bach to Brahms. Its application to music of earlier and later periods has been made by Felix Salzer (1904-). In the present study no attempt is made to discover a fundamental melodic line, or structural harmonic cadence of the Schenker-Salzer type. Instead, this study is restricted to the establishment of the progressions of the basic roots (for which in the proper place the term "foundation tones" is introduced,) the essential intervallic and chordal structure erected on these roots, and of the principle of organization governing the successions of the root tones. This

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

limitation was made to avoid the danger of projecting into this music a view of structure prejudiced by the theory and practice of the classical and romantic periods.

In the organization of this study first consideration was given to the number of voices participating in the various compositions. Accordingly the three main chapters deal respectively with two, three and four voice works. Within each chapter separate consideration is given to the Ballades, Rondeaux, and Virelais. Ten compositions are presented in detailed analysis, three in partial analysis, and the remaining fifty-one are merely classified according to form.

The analysis of these compositions reveals that tonal movement in this music is affected largely by the stepwise connection of foundation tones, which support either real or implied $\frac{5}{3'}$ $\frac{5}{8'}$ $\frac{6}{3'}$, or $\frac{6}{5}$ vertical sonorities. No one voice serves the particular function of sounding the foundation tone because of frequent voice crossing. Thus, the stepwise shift of vertical sonorities serves as a quasi-abstract background, within which florid melodic designs take place.

The direction of the stepwise connection of foundation tones is determined by tetrachord schemes. One or more such schemes determine the tonal center, and the movements toward and away from it. This principle is operative in both the over-all tonal movement and the internal phrase structure.

The most frequent instance of disjunct connection of foundation tones occurs when a leap is made from the lowest to the highest tone of the organizing tetrachord, in order that a new drive down through the tones of the tetrachord may begin.

The largest number of deviations from these generalizations occur in the three voice texture, while a more rigid adherence to them is apparent in the two and four voice texture. 125 pages. $1.56. Mic 56-1529

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

STUDIES ON OFFICIAL SPECIES OF ALOE

(Publication No. 14,476)

Nouri Yusuf Mary, Ph.D.
The Ohio State University, 1955

A literature review of aloe indicated that there is still considerable question with regard to its chemical composition. In addition, it was found that most of the work that appeared in the literature was conducted almost entirely on one official species of aloe (Curaçao). The other two official species (Cape and Socotrine) have seldom been studied or investigated for their constituents. This investigation was, therefore, undertaken to ascertain the constituents present in official species of aloe, and to quantitate, if possible, some or all of the active medicinal constituents contained. Aloin and cascara sagrada were also included in this investigation.

The constituents of aloe were separated by the use of paper chromatography, a technique which has never been used previously for the analysis of aloe.

The nature of the investigation undertaken necessitated that pure authentic specimens of some anthracene derivatives be available. Accordingly, aloe-emodin, aloe-emodin-anthranol, chrysophanic acid, and emodin were prepared. The maximum absorption of each of these compounds was determined to help identify and quantitate the constituents present in aloe, aloin, and cascara.

Since the anthracene-derivatives of aloe, aloin, and cascara are present in the free state as well as in glycosidal combination, extracts representing each were prepared. The free derivatives were extracted with chloroform, and the combined derivatives were freed by hydrolysis with 30 per cent H_2SO_4 and also extracted with chloroform. The free and combined extracts from each of the drugs investigated were spotted on Whatman No. 1 filter paper strips (4 x 60 cm.) and chromatographed ascendingly for 10-12 hours in a tightly sealed chamber. Petroleum ether (b.p. 65 - 110°) saturated with 97 per cent methyl alcohol was used as the solvent. At the end of 10-12 hours the developed paper strips were removed from the chromatographic chamber. The solvent front was marked, and the strips were air-dried and then treated with 0.5 per cent methanolic magnesium acetate solution to bring about an orange, pink, or yellow coloration of the separated spots. The identity of the spots from each drug investigated was established by matching their Rf values with the Rf values of the pure compounds chromatographed simultaneously with the drug extracts. The maximum absorption of the eluted spots served as a further criterion for identification.

The results of the experiments conducted showed that curaçao aloe contained anthranol, aloe-emodin, and chrysophanic acid; cape aloe and aloin contained anthranol and aloe-emodin only; socotrine aloe contained anthranol, aloe-emodin, and an unidentified compound; and cascara sagrada contained anthranol, aloe-emodin, emodin, and chrysophanic acid. All the constituents mentioned, except the unidentified compound in Socotrine aloe, occur free and combined. The unidentified compound in Socotrine aloe occurs in the free state.

A quantitative measurement of some of the constituents of aloe was made. The results showed that the anthracene derivatives were present in far greater quantities in glycosidal combination than they were in the free state. It was also found that Curaçao aloe was superior in its measurable anthracene-derivatives content to Cape aloe, and Cape was superior to Socotrine aloe.

Included in this investigation, also, was a study of the effect of some selected surface active agents on the extraction of the active constituents of Cape aloe. Tween 80 (a non-ionic surfactant), Tergitol 08 (an anionic surfactant), and Cetab (a cationic surfactant) in 0.25, 0.50, and 1.0 per cent concentrations were used. The results showed that Tween 80 and Cetab increased the amount of free and combined anthracene derivatives extracted from Cape aloe. This increase was proportional to the concentration of the surfactant used. Tergitol 08, however, set free the anthracene derivatives from their glycosidal combination, and thus increased the amount of free anthracene derivatives considerably. This is not favored since the anthracene derivatives are active therapeutically, mainly as glycosides. Tergitol 08 is, therefore, not recommended for the extraction of glycosidal drugs.

107 pages. $1.34. Mic 56-1530

A STUDY OF A RADIOMETRIC ANALYSIS OF PHENOBARBITAL

(Publication No. 16,485)

Myron Paikoff, Ph.D.
Purdue University, 1956

Major Professor: John E. Christian

A study was undertaken to determine the feasibility of utilizing inorganic salts as labelling reagents in a radiometric analysis of phenobarbital.

Mercury-203 in the form of mercuric perchlorate was used as the labelling reagent. The mercury-203 was obtained in the form of the nitrate. The nitrate was decomposed to the oxide and then converted to the perchlorate by the addition of perchloric acid.

Mercuric phenobarbital, to be used as the carrier, was prepared by reacting a phenobarbital solution with an excess of mercuric perchlorate. The precipitate was collected by filtration and dissolved in a dilute sodium hydroxide solution. The solution was filtered, precipitated with glacial acetic acid, and collected. The mercuric phenobarbital was solubilized a second time with the sodium hydroxide solution and filtered. The filtrate was collected, the mercuric phenobarbital re-precipitated with glacial acetic acid, collected, washed four times with distilled water, and dried.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

The radioactive derivative was prepared on Whatman No. 1 filter paper 5 cm. by 42 cm. The paper was spotted 10 cm. from the top with excess mercuric-203 perchlorate and then with the phenobarbital solution. The paper was placed in a chromatography jar and a distilled water front was allowed to pass over the reaction area for 48 hours. The chromatogram was then removed and dried.

The phenobarbital was analyzed in two ways. The segment of paper containing the derivative was cut out and placed directly under the Geiger Müller Tube and its activity determined. The results of this mode of analysis was termed the "Direct Method." The specific activity of the derivative was determined by adding sufficient dilute sodium hydroxide solution in which 10 mg. of carrier had been previously dissolved, to that segment of the chromatogram containing the radioactive derivative. Following an elution period of one hour, the eluated derivative was purified and plated out on specially prepared planchets, and its specific activity determined. This method of analysis has been termed the "Carrier Method."

This radiometric procedure was found capable of analyzing levels of phenobarbital as low as 1.0 microgram with an overall error of less than 25 per cent. Both procedures, the "Carrier Method" and the "Direct Method" gave relatively the same degree of precision and accuracy. This procedure theoretically could be applied to other barbiturates.

The method is limited to the analysis of barbiturate samples free of impurities which react with mercury to form insoluble substances. This is exemplified by the fact that attempts to quantitatively separate microgram quantities of phenobarbital from serum in sufficient purity for the radiometric analysis failed.

73 pages. $1.00. Mic 56-1531

THE INFLUENCE OF CERTAIN NONNARCOTIC ANALGESICS ON THE OXYGEN UPTAKE OF RAT LIVER SLICES

(Publication No. 16,499)

Bob West, Ph.D.
Purdue University, 1956

Major Professor: Dr. T. S. Miya

An investigation was made of the effects of various factors and analgesic drugs on the oxygen consumption of rat liver slices by the use of the Warburg technique. Bilateral hind leg tourniquets wound tightly and tied as high up on the leg as possible caused a marked increase in oxygen consumption of excised liver slices from animals subjected to this treatment. Experiments with acetylsalicylic acid, 600 mg./Kg. and salicylamide, 200-300 mg./Kg. indicate that these drugs do not block the increased oxygen uptake due to tourniquet shock.

Orally administered acetylsalicylic acid, 600 mg./Kg. and 700 mg./Kg. resulted in increases in oxygen uptake of the excised liver slices of 17.47 and 27.12 percent respectively. Sodium salicylate, 400 mg./Kg. produced an increase of 25.97 percent. The minimal effective dose for stimulation of oxygen consumption by salicylamide was 300 mg./Kg.

The oral administration of acetophenetidin, 750 mg./Kg. resulted in an increase of 17.93 percent. At 200 mg./Kg. the pyrazolon derivatives, aminopyrine and antipyrine, produced increases of 19.62 percent and 17.93 percent respectively in oxygen uptake. Slight increases were also noted after the oral administration of morphine sulfate, 10 mg./Kg. and sodium phenobarbital, 25 mg./Kg.

The in vitro addition of sodium salicylate, salicylamide, acetylsalicylic acid, and antipyrine to the liver slices in the Warburg flasks in molar concentrations from 0.00005 to 0.001 Molar did not increase oxygen consumption. Morphine sulfate in concentrations of 1×10^{-3} Molar and 2.5×10^{-3} Molar did not exert an effect on oxygen uptake. Similar results were obtained with sodium phenobarbital at concentrations of 1×10^{-6}, 1×10^{-5} and 1×10^{-3} Molar.

The observed stimulation of oxygen consumption following pretreatment with these drugs is not due to an activation of the adrenal pituitary axis since pretreatment with ACTH and cortisone did not alter oxygen uptake.

78 pages. $1.00. Mic 56-1532

PHILOSOPHY

THE PHILOSOPHY OF LUCIUS ANNAEUS SENECA

(Publication No. 16,398)

Thomas Patterson Hardeman, Ph.D.
University of Illinois, 1956

A brief glance at Seneca's life shows the severity of the tests to which his particular milieu subjected Stoicism. That he remained a Stoic is the conclusion of this thesis. Agreeing with Stoic pantheism, but influenced also by Epicurus, Plato and other philosophers, he built his philosophy around the fundamental demand: "Follow Nature". Though his various works are addressed to individual acquaintances, Seneca conceived his mission to be that of a teacher of the human race. His philosophical program was of great scope. He sought in the Natural Questions to ground the

Stoic ethical ideal in the Divine scheme of things, and consequently he felt compelled to defend the perfection of Nature. This he did in De Providentia and elsewhere, basing his defence ultimately on the inability of the Maker to overcome the imperfections inherent in matter.

His program also included (1) Consolations, in which he showed the comfort which Stoic philosophy can give to the distressed; (2) Essays in which different aspects of the good life were discussed; (3) various works, e.g., Ad Polybium, Apocolocyntosis, and the Octavia, in which the seamy side of contemporary imperialism was satirized; (4) two unique educational attempts, (a) education through friendship, in the Epistles, and (b) education through representation, in the Tragedies; (5) several works specifically aimed at building up the society permeated by humanitas. The De Ira seeks to combat anger, the chief foe of the cosmopolis and the De Clementia pleads for one of the virtues necessary to humanitas. Finally, in De Beneficiis, Seneca seeks to inculcate the charitable spirit which makes for good will in an ever widening circle.

Seneca accepted the strict determinism involved in the Stoic notion of Fate, and felt keenly the difficulty of harmonizing this determinism with the freedom of will presupposed in his ethics. However, the conviction that there are two realms, Fate and Freedom, is basic to his anthropology, psychology and ethics.

Anthropology pictures man as a citizen in these two realms. His body is governed by Fate, and therefore, its pains and diseases are inescapable. The mind, however, has the power to refuse consent to bodily impulses, which are "natural" only in the sense of occurring in man because of his bodily structure. This makes possible that phase of Stoic epistemology which exalts ratio, and gives it the power of avoiding passions, by refusing assent to those impulses which if allowed to become excessive, will upset the government of ratio. The same doctrine, applied to ethics, explains man's ability either to acquiesce in the order of "Nature," here made the Norm for mankind, or to be forced unwillingly to obey the decrees of Fate.

The greater part of Seneca's writing concerns the exaltation of virtue as the only true good. In this context are to be placed both his insistence that the Stoic paradoxes contribute to such exaltation, and also the different definitions of virtue found in his writings. For example, to say that virtue is living in accordance with Nature and to say that virtue is living reasonably are the same, because Nature is completely rational. Similarly, to identify virtue with the mind perfected in the art of making good choices is the same as to say that virtue is the mind of the sage, and to ascribe to the sage tranquillity, invulnerability and many other remarkable qualities is simply one way to express the conviction that virtue is the only true good. Whether or not the sage exists, the ideal is the important thing. 398 pages. $4.98. Mic 56-1533

PHYSICS, GENERAL

INTERNAL FRICTION OF COPPER AND COPPER ALLOYS

(Publication No. 16,383)

Daniel Newson Beshers, Ph.D.
University of Illinois, 1956

The internal friction or damping of oscillations of solids has been studied quantitatively, but sporadically, since the early nineteenth century. In recent years a number of particular examples of this phenomenon have been observed in detail, and many of them have been satisfactorily described in terms of detailed mechanisms. One type of damping which has proved particularly difficult to understand is the non-linear, or amplitude dependent, damping first observed by Read, and believed to be due to dislocation motion. It is this damping which is the subject of this thesis.

In the work reported here, the emphasis has been on studying the variation of the decrement with several quantities in an effort to obtain analytic expressions for the variation which would be relatable to theory. The independent variables were amplitude, temperature, impurity concentration, and time, when appropriate.

The copper used in this work was 99.999% pure. Some of the specimens had small amounts of pure gold added to them. All of the measurements were conducted on single crystals. The preparation techniques followed those of Marx and Weertman.

The measurements were made using Marx's piezoelectric driver-gauge technique. A corrected description of the principle of this method is given.

The amplitude dependence in the pure materials was similar to that reported previously. In the alloys it was similar to that reported previously by Weertman and Salkovitz for lead alloys. It was found that the decrement rose with increasing amplitude according to $\triangle = \triangle_o + B_e^{-A/\epsilon}$. Where $\triangle$ is the decrement, ϵ is the amplitude of oscillation, and A and B are constants. A and B were independent of temperature up to 300°C or 400°C. This is in satisfactory agreement with the Koehler-Granato-Lücke theory of the damping due to breakaway of dislocations pinned by impurity atoms. A is found to vary linearly with concentration as predicted by the theory.

At temperatures above 150° to 175°C, and at amplitudes of oscillation appreciably above breakaway, an increase of damping with time at constant amplitude of oscillation may be observed. If the amplitude is reduced, then the damping returns to its original value. It is shown that this increase must be due to the diffusion of point defects either towards or away from the dislocations. It is further observed that this time dependence obeys the Cottrell- Bilby- Harper law for such diffusion. Estimating the density of

dislocations and D_0 for the diffusion of the point defect, we find that the activation energy for the diffusion is 0.7 ± 0.3 ev/atom. Comparison of the behavior in pure and alloy specimens leads to the conclusion that the time-dependent dissipation is due to an interaction between moving dislocations and lattice vacancies, the latter being the diffusing defect, and that vacancies are being created in the process.

If the decrement at zero amplitude is measured as a function of temperature, then a plot of log Δ vs 1/T tends to show straight lines with breaks above 280° C in the pure material. The slopes of these lines are 0.7 ev/atom and 1.0 ev/atom, which are close to well-known values for processes in copper, lending support to the idea that vacancies may interact with dislocations to give a damping. The temperature of the rise seems to correspond to the onset of other processes known to depend on self-diffusion. Estimates of the number of vacancies that might be present from both the time and the temperature dependences, gives an order of magnitude agreement: 10^{-10} mole fraction. 94 pages. $1.18. Mic 56-1534

SOME RECENT EXPERIMENTS WITH VHF RADIO ECHOES FROM AURORA AND THEIR POSSIBLE SIGNIFICANCE IN THE THEORY OF MAGNETIC STORMS AND AURORAS

(Publication No. 15,581)

Kenneth Ludlam Bowles, Ph.D.
Cornell University, 1955

The results of two experiments dealing with VHF radio echoes "associated with aurora" are described. In the first, most of the echoes are shown to come directly from ionization in the near vicinity of some visible forms. Echoes are obtained from homogeneous, rayed and pulsating forms. However, there is little relation between the luminosity of the forms and the intensity of the radio signals. The range and azimuth distributions of the echoes are shown to be consistent with a propagation mechanism involving ionized columns as scattering centers. The columns should lie parallel to the lines of force of the earth's magnetic field.

In the second, the R.F. spectra of the auroral echoes are studied. The signals are both spread and Doppler shifted in frequency relative to the transmitted carrier. The spectra are generally asymmetric about their mean values. Various tests have shown that the implied motions are not closely related to movements of the visible forms, ionospheric winds or ionospheric currents. However, upward shifted echoes correlate with homogeneous or pulsating forms while downward shifted echoes correlate with rayed forms.

It is concluded that the motions are identified with the directions of motion of the primary exciting particles in the aurora. These particles might be downcoming protons traveling along the earth's lines of force in homogeneous forms. However the rayed forms are probably caused by upward discharges of protons or ions. Pulsating forms may be a special case of downcoming protons or ions. It is suggested that the critical phase of an auroral disturbance, when homogeneous forms give way to rayed forms, comes when the particle density in the solar ion stream stops increasing and begins to decrease.

70 pages. $1.00. Mic 56-1535

TRANSIENT METHODS FOR MEASURING THE MOISTURE DIFFUSIVITY OF POROUS MEDIA

(Publication No. 16,384)

Robert Russell Bruce, Ph.D.
University of Illinois, 1956

The differential equation of flow derived from Darcy's law and the equation of continuity may be written as follows for the case of horizontal flow:

$$(1) \qquad \frac{\partial \theta}{\partial t} = \frac{\partial}{\partial x}\left(k(\theta)\,\frac{\rho}{\eta}\,\frac{\partial \Psi}{\partial \theta}\,\frac{\partial \theta}{\partial x}\right)$$

where θ = the liquid volume fraction
t = time
x = horizontal distance co-ordinate
$k(\theta)$ = unsaturated intrinsic permeability
ρ = liquid density
η = liquid viscosity
Ψ = capillary potential

To be useful, this flow equation must be solved for any given set of boundary and initial conditions.

It has been observed that this differential equation of flow is similar to the non-linear diffusion equation. A quantity called moisture diffusivity, $D(\theta)$, was then substituted for the quantity $k(\theta)\,\frac{\rho}{\eta}\,\frac{\partial \Psi}{\partial \theta}$ and the flow equation was written as follows:

$$(2) \qquad \frac{\partial \theta}{\partial t} = \frac{\partial}{\partial x}\left(D(\theta)\,\frac{\partial \theta}{\partial x}\right)$$

Solutions of equation (2) can only be obtained if the $D(\theta)$ function is known. A treatment of equation (2), attributed to Boltzmann was used to calculate $D(\theta)$ values for a horizontal flow system. The expression used to calculate $D(\theta)$ may be written as follows:

$$(3) \qquad D(\theta)_x = -\frac{1}{2t}\left(\frac{dx}{d\theta}\right)_{\theta_x} \int_{\theta_i}^{\theta_x} x\,d\theta$$

where θ_i = initial liquid volume fraction of flow column.
θ_x = liquid volume fraction at point x at time t.

Water at zero hydraulic head was applied to one end of semi-infinite, horizontal columns of uniformly packed sands and glass beads at a uniform moisture content throughout their length. After water was allowed to move into the columns for a time, inflow was ceased, the column was sectioned and the moisture content of each section determined. From plots of the moisture contents of the porous columns as a function of distance from the free water surface $dx/d\theta$ and $\int_{\theta_i}^{\theta_x} x\,d\theta$ were estimated for several values of θ_x and values of $D(\theta)$ calculated.

The moisture content consistently decreased with

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distance from the free water surface, rather rapidly at first, then slower in the transmission zone and then very rapidly at the wetting front. The moisture diffusivity values, calculated using these curves, show a maximum diffusivity at some moisture content below saturation. This result occurs because of the concave upward portion of the moisture content distribution curves near the source of free water. Use of columns at different initial moisture contents indicated that the slope of the wetting front, $dx/d\theta$, increased as the initial moisture content was increased. This experimental observation is predicted from equation (3).

Unsaturated permeability values were calculated from moisture characteristic curves by the method of Childs and Collis-George. A steady state apparatus, proposed by Richards and Moore, was also used to obtain unsaturated permeability values. Recalling that $D(\theta) = k(\theta) \frac{\rho}{\eta} \frac{d\psi}{d\theta}$, values of $D(\theta)$ were calculated using the slopes of the moisture characteristic curves for the porous media and the values of $k(\theta)$ determined. The values of $D(\theta)$, calculated using the values of $k(\theta)$ resulting from the Childs and Collis-George method, were similar to those calculated from the Boltzmann expression. The values of $k(\theta)$, determined by the steady state method, were decreased as the length of flow period was increased and affected the $D(\theta)$ values similarly.

Assuming the moisture diffusivity to be relatively constant within narrow limits of moisture content, equation (2) can be written as follows:

$$(4) \qquad \frac{\partial \theta}{\partial t} = D \frac{\partial^2 \theta}{\partial x^2}$$

A solution of equation (4) was obtained for a closed, finite system. Experimental difficulties made it impossible to secure reliable data.

If the moisture diffusivity is considered relatively constant within narrow limits of ψ, equation (2) can also be written in the following form:

$$(5) \qquad \frac{\partial \psi}{\partial t} = D \frac{\partial^2 \psi}{\partial x^2}$$

Solutions of this equation for finite systems with one open boundary were obtained. The case of a constant potential at the open boundary and the case of the potential varying exponentially with time was considered. Samples of saturated porous materials were desorbed by applying small increments of tension to a porous plate in contact with one end of the samples. During these desorption periods the outflow was measured as a function of time. The following relationship between outflow, q, and potential at the open boundary was used:

$$(6) \qquad q = -\int_0^t \frac{k \rho}{\eta} \left(\frac{\partial \psi}{\partial x}_{\ell}\right) dt$$

Combining equations (5) and (6) and using the outflow data, values of D were calculated for each increment of moisture tension.

The expression derived for the case of the open boundary varying exponentially with time failed to yield explicit values of D. The moisture diffusivity values, calculated when a constant boundary potential was assumed, were reasonable in magnitude. It was clearly indicated that neither the assumption of an exponentially varying potential or constant potential fitted the experimentally observed outflow relationship.

Of the methods investigated the use of experimentally determined moisture distribution curves and the Boltzmann treatment of the non-linear diffusion equation was the most successful method for measuring moisture diffusivity. Although this method lacks precision, the data obtained have indicated the nature of the $D(\theta)$ function.

153 pages. $1.91. Mic 56-1536

A STUDY OF THE LATTICE-SCATTERING MOBILITY OF HOLES IN P-TYPE GERMANIUM AND SILICON

(Publication No. 12,365)

Henry Ehrenreich, Ph.D.
Cornell University, 1955

The temperature dependence of the lattice-scattering mobility of holes in both germanium and silicon has been determined experimentally as about $T^{-2.3}$, in disagreement with the theoretically predicted temperature dependence of $T^{-1.5}$, obtained by assuming that conduction takes place in a single valence band whose wave functions and energy surfaces near the band edge, at $\underline{k} = 0$, have spherical symmetry.

The present study attempts to resolve this disagreement by a detailed calculation of the hole mobility using the valence band structure as established by cyclotron resonance experiments. Approximately correct wave functions have been used and scattering of holes within and between the two bands degenerate at $\underline{k} = 0$, and characterized by effective masses 0.04 and 0.3 times the free electron mass, has been taken into account. The principal approximations that have to be made are the following:

(1) The surfaces of constant energy in k-space are assumed spherical. The slight warping in the [111] directions is not taken into account.
(2) The energy is considered to be a quadratic function of k. The influence on the energy surfaces of the third valence band, split off by spin-orbit coupling, has thus been neglected.
(3) The cellular part of the wave function is assumed to possess pure p character.

Only one unknown constant C, equal to the kinetic energy at $\underline{k} = 0$ enters the theory. Using the effective mass data from cyclotron resonance experiments and assuming reasonable values of C, the theoretical mobilities at room temperature are found to be five times larger than experimental values and to have the same $T^{-1.5}$ temperature dependence as that obtained from the earlier, simpler calculations.

Holes are seen to be scattered equally effectively by longitudinal and transverse acoustical phonons. The scattering within a band is largely determined by longitudinal phonons, whereas the scattering between bands is due primarily to transverse phonons. The probabilities of scattering show a marked angular dependence: the lighter holes are scattered predominantly in the backward direction, and those of heavier mass largely in the forward direction. The lighter holes are about five times more mobile than the heavier holes, but carry only 20 per cent of the current.

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Several further possibilities that might alter the temperature dependence of the mobility are considered. Umklappprozesse are seen to be entirely unimportant. The effect of optical modes, calculated on the basis of the deformable ion mode, is seen to be negligible. The temperature dependence produced by the change of effective mass values due to the self-energy interaction with the phonon field is far too small to alter the final result.

It is shown that second and higher order scattering effects, caused by a perturbation that is linear in the atomic displacements, leading to the simultaneous creation or annihilation of more than one phonon, need not be considered, since first order perturbation theory gives the probability that at least one phonon is emitted or absorbed during a scattering process. A first order perturbation calculation thus includes automatically the effect of such processes on transport theory.

The temperature dependence of the lattice-scattering mobility of holes in germanium and silicon remains unexplained. 155 pages. $1.94. Mic 56-1537

PROBLEMS IN HIGH ENERGY QUANTUM ELECTRODYNAMICS (PARTS I AND II)

(Publication No. 16,118)

James Joseph, Ph.D.
State University of Iowa, 1956

Chairman: Associate Professor Fritz Rohrlich

Part I
MULTIPLE PHOTON PRODUCTION BY ELECTRON PAIR ANNIHILATION IN FLIGHT

Starting from first principles, i.e., with the Feynman-Dyson S matrix, we have computed the two leading terms in the high energy expansion of the cross section σ_n for multiple photon production by electron pair annihilation in flight. The result is

$$\sigma_n \simeq \sigma_2 \frac{1}{(n-2)!} \left\{\frac{2\alpha}{\pi} \ln\left(\frac{\gamma_+}{\epsilon}\right) \left[\ln(2\gamma_+)-1\right]\right\}^{n-2}$$

where α is the fine structure constant, $\epsilon\, m c^2$ is the experimental energy resolution, and $\gamma_+ m c^2$ is the position energy in the laboratory system. This formula is valid provided $\ln\left(\frac{\gamma_+}{\epsilon}\right) >> 1$ and $\gamma_+ >> 1$.

By a simple substitution for final and initial momenta in the transition probability distribution for Double Compton Scattering we obtained the probability distribution for three-photon production. The distribution was integrated in the high energy limit. We obtained thereby the more accurate result

$$\sigma_3 \simeq \sigma_2 \frac{2\alpha}{\pi}\left\{\left[\ln\left(\frac{\gamma_+}{\epsilon}\right) + \frac{1}{2}\right]\left[\ln(2\gamma_+)-1\right] + \frac{\pi^2}{6}\right\}$$

which includes the first four terms. This formula is for $(\gamma_+/\epsilon) >> 1$ and $\gamma_+ >> 1$. In the limit $\ln(\gamma_+/\epsilon) >> 1$ it reduces to σ_n for $n = 3$.

A previous estimate of the first term in the extreme relativistic limit $\ln \gamma_+ \gg 1$ by Gupta for σ_n and for σ_3 exhibited a discrepancy between σ_3 and σ_n for $n = 3$. He attributed this discrepancy to several simplifying assumptions made by him. We have justified these assumptions.

We find that for energies $10 \lesssim \gamma_+ \lesssim 10^3$ and energy resolutions $\ln(\gamma_+/\epsilon) \sim 4.6$ that three-photon production may be observable. On the other hand, the results agree with Gupta's original conclusion that the Schein event, which consisted of a shower of about twenty photons in a narrow cone, cannot be accounted for by electromagnetic processes.

Part II
ELECTRON PAIR PRODUCTION BY PHOTONS IN ATOMIC HYDROGEN

We have extracted the electron recoil distribution from the work of Votruba on electron pair production by photons colliding with free electrons. With the free electron recoil distribution we were able to correct the screening calculations of Wheeler and Lamb. They neglected the recoil energy and exchange and found for complete screening in atomic Hydrogen $\sigma_{coh} = 16.4$ and $\sigma_{incoh} = 19.8$ for the coherent and incoherent scattering cross sections in units of αr_0^2. We find that the recoil energy is indeed negligible, but that exchange modifies their results to $\sigma_{coh} = (16.8 \pm 0.4)$ and $\sigma_{incoh} = 16.1$. Exchange gives a smaller electronic momentum transfer distribution and therefore decreases the incoherent cross section, but increases slightly the coherent cross section due to the (negative) interference term between nuclear and electronic momentum transfers.

One could expect that because of the inherent similarity of the Bremsstrahlung and pair production processes, the exchange effect is of the same order of magnitude. We found that for pair production, the total cross section is smaller than the Wheeler-Lamb value by 10%. The latest report by Panofsky on the measured cross section for Bremsstrahlung in Hydrogen gives a total cross section which is smaller than the Wheeler-Lamb value by (9 ± 2)%.

In order to check our electron recoil distribution, we computed the integral cross section for pair production by photons colliding with free electrons. The result was the cross section

$$\sigma = \alpha r_0^2 \left\{\frac{28}{9} \ln(2k) - \frac{106}{9}\right\}$$

where r_0 is the classical electron radius, and $k\, m c^2$ is the incident photon energy. This cross section is more accurate than Votruba's result

$$\sigma = \alpha r_0^2 \left\{\frac{28}{9} \ln(2k) - \frac{(102 \pm 4)}{9}\right\}$$

valid for $k^{-1} \ln k \ll 1$. 99 pages. $1.24. Mic 56-1538

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THE REFLECTING POWER OF IRON FOR ULTRAVIOLET LIGHT AS A FUNCTION OF TEMPERATURE IN THE NEIGHBORHOOD OF THE A_3 POINT

(Publication No. 16,199)

Virgil Omar Naumann, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor H. B. Wahlin

An experiment was carried out to determine the behavior of the reflecting power of iron for ultraviolet light of wavelength 2537 Å in the neighborhood of the A_3 point where iron undergoes a phase change from a body-centered cubic crystal to a face-centered cubic crystal.

A flat iron filament, surrounded by a molybdenum cylinder, was sealed in an evacuated glass tube and was heated by passing a current thru it. Ultraviolet light was focused on the iron. A certain percentage of this light is reflected off of the iron and onto the molybdenum cylinder. The photoelectrons ejected by the molybdenum were used to measure the intensity of the reflected light. The intensity of the incident light was measured by moving the ultraviolet light a little until all of the light fell on the molybdenum cylinder beside the iron and then measuring the photocurrent. The reflecting power is the ratio of the intensity of the reflected light to the intensity of the incident light.

An abrupt increase of about .07 in the reflecting power of iron for ultraviolet light of wavelength 2537 Å was found at the A_3 point. The ratio of the reflecting power of γ-iron, the face-centered cubic phase, to the reflecting power of α-iron, the body-centered cubic phase, at the A_3 point was found to be 1.16.

This change in the reflecting power of iron at the A_3 point was caused by a change in the electronic structure of the iron when iron changes phase. Using the free electron model of a metal the Fermi energy for α-iron and for γ-iron were calculated. These values agreed very well with the values of the Fermi energies calculated from the lattice parameters of α-iron and γ-iron.

29 pages. $1.00. Mic 56-1539

THE SPECIFIC HEAT OF LIQUID HELIUM BETWEEN 0.4 AND 1.0°K

(Publication No. 16,201)

Douglas Campbell Pearce, Ph.D.
The University of Wisconsin, 1956

Supervisor: Associate Professor Joseph R. Dillinger

The specific heat of liquid helium between 0.4 and 1.0°K was measured under its saturated vapor pressure using a metal calorimeter of the "open capsule" design. A carbon resistor was used as a thermometer. A feature of the calorimeter, not utilized by previous workers, was that helium samples of different size up to 2.5 grams could be studied. Consequently, the uncertain correction for the heat capacity of the paramagnetic refrigerant was eliminated by using a subtractive process in the analysis.

The metal calorimeter had a background heat leak of about one half that of any similar system described in the literature. Furthermore, it appeared that a carbon resistor, as used in this work, was a reliable thermometer for the temperature interval pertinent to this investigation.

The measured values of the specific heat of liquid helium under its saturated vapor pressure, C_s, could be represented by the following equation:

$$C_s = 5.5 \times 10^{-3} T^3 + 265\left[1 + \frac{T}{9.55} + \frac{3}{4}\left(\frac{T}{9.55}\right)^2\right] \frac{e^{-\frac{9.55}{T}}}{T^{3/2}} \quad \frac{\text{cal.}}{\text{gm. deg.}} .$$

An equation of this type had been suggested by Landau. (Jour. Phys. (USSR) 5, 71, 1947). Consequently, these results are considered to be evidence in favor of a theory of liquid helium of the general form advanced by Landau.

111 pages. $1.39. Mic 56-1540

APPROACH TO EQUILIBRIUM IONIZATION BEHIND STRONG SHOCK WAVES IN ARGON

(Publication No. 15,522)

Harry Ewald Petschek, Ph.D.
Cornell University, 1955

In previous work at Cornell[1,2,3] a shock tube technique for producing shock waves up to Mach number 20 in argon has been developed. It has further been shown that the hot gas behind the shock wave reaches equilibrium in the times available in the shock tube ($< 10^{-3}$ sec.). Equilibrium temperatures up to about 15,000°K can be achieved in this manner. Under this condition about 25% of the argon atoms have become ionized. The problem considered here is the kinetics of the approach to equilibrium.

Theoretical considerations indicate that for large degrees of ionization the dominant ionization process should be ionization by electron-atom collisions. The rate of this reaction is determined primarily by the rate at which energy can be transferred to electrons by elastic collisions with ions. Since these collisions are determined by the coulomb field, the computed rate depends primarily on the fundamental constants and only secondarily on the inelastic collision cross-sections. A previous theoretical treatment by Bond[4] is in error by a factor of about 10^3 because he has tacitly assumed that the rate of energy transfer by elastic collisions is rapid enough to maintain equal electron and atom temperatures.

The rate of ionization for degrees of ionization close to equilibrium ($\approx \frac{1}{2}$) has been observed by photomultiplier measurements of the continuum light intensity and by measurements of the electrostatic potential set up in the gas due to the diffusion of electrons. Both measurements are in agreement (within a factor of two) with the calculated rate of ionization due to electron-atom collisions.

The time between the shock wave and the equilibrium region has been measured by inserting a rod in the shock tube which reflects the incident shock wave. The high temperature gas behind the reflected shock wave becomes luminous very rapidly. The shock wave is then located on

rotating drum camera pictures by the appearance of luminosity at the end of the rod. Since due to the electron-atom ionization process the light intensity increases rapidly near equilibrium, the equilibrium region behind the incident shock is also clearly defined on the pictures. This time has also been measured from the oscillograms of the diffusion potential.

Integration of the calculated rate of ionization due to electron-atom collisions over the measured time required to reach equilibrium shows that there must be an initial ionization mechanism which produces about 10% of the equilibrium degree of ionization. Radiation and the rapid ionization of easily ionizable impurities cannot account for the initial ionization.

The measured times required to reach equilibrium can be fitted at a single density if the initial ionization mechanism is assumed to be due to atom-atom collisions. The required cross-section for this process is about 10^{-17} cm.^{2} and the activation energy is equal to the energy of the first excited state of argon (11.5 e.v.). Although this rate is not inconsistent with theoretical considerations of inelastic collisions between atoms, it is considerably larger than one would expect. The experimental density dependence of the time required to reach equilibrium does not support the assumption that the initial ionization is due to atom-atom collisions.

Some very slight indication that there might be an appreciable production of ionization in the shock front was also observed. 121 pages. $1.51. Mic 56-1541

1. Resler, Lin and Kantrowitz, J. Appl. Phys. 23, 1390 (1952).

2. Lin, Resler, and Kantrowitz, J. Appl. Phys. 26, 95 (1955).

3. Petschek, Rose, Glick, Kane, and Kantrowitz, J. Appl. Phys. 26, 83 (1955).

4. Bond, Los Alamos Scientific Laboratory Report, LA-1693.

THE INFRARED DISPERSION OF HYDROGEN BROMIDE AND CARBON TETRAFLUORIDE

(Publication No. 16,207)

Bertram D. Schurin, Ph.D.
The University of Wisconsin, 1956

The refractive indices of hydrogen bromide and carbon tetrafluoride have been measured in the infrared region of the spectrum and the data used to investigate the distribution of charge associated with the molecular bonds of the two molecules.

For hydrogen bromide the data has been taken between 1 and 12 microns. The contributions of the vibrator-rotator as well as the pure rotator have been determined and the results used to calculate the dipole moment of the bond between the atoms (μ) and the rate of change of dipole moment with internuclear distance ($d\mu/d\eta$). The measurements yield values of:

$$\frac{d\mu}{dr} = (0.48 \pm 0.04) \times 10^{-10} \text{ e.s.u.}$$

$$\mu = (0.82 \pm 0.04) \times 10^{-18} \text{ e.s.u.} .$$

The measurements on carbon tetrafluoride have been made between 1 and 20 microns. The absolute intensities of the two infrared active bands (ν_3, ν_4) have been determined from their contributions to the index. The results are:

$$A_3 = (1.60 \pm 0.04) \times 10^{14} \frac{\text{cm.}^{-1}}{\text{sec.}}$$

$$A_4 = (1.86 \pm 0.17) \times 10^{12} \frac{\text{cm.}^{-1}}{\text{sec.}} .$$

The equation representing the dispersion in both the visible and infrared regions, when extrapolated to zero frequency, should yield a refractive index whose square is equal to the temperature invariant part of the static dielectric constant. For carbon tetrafluoride the contributions of the infrared bands to m^2_∞ are large and account for better than 90% of the discrepancy between the optical index extrapolation and the dielectric constant measurement. In the case of hydrogen bromide the contribution of the vibrator-rotator is in the correct direction. However, the magnitude of the discrepancy as well as the vibrator-rotator contribution of 3×10^{-6} are both within the limit of error for the dielectric constant measurement.

47 pages. $1.00. Mic 56-1542

PHYSICS, ELECTRONICS AND ELECTRICITY

THERMOELECTRIC POWER, ELECTRICAL RESISTANCE, AND CRYSTALLINE STRUCTURE OF CARBONS

(Publication No. 13,747)

Egon E. Loebner, Ph.D.
The University of Buffalo, 1955

The purpose of this investigation was to study the effect of heat treatment on the thermoelectric power, electrical resistance, and crystalline structure of soft and hard carbons, graphite, carbon blacks, and pulverized carbons. No systematic study of the thermoelectric power and its dependence on heat-treatment as well as correlation with the electrical resistance and the crystalline structure of the same carbon had been reported previously. Also, certain consequences of the energy-band model for polycrystalline carbons, proposed by Mrozowski, were subjected to experimental test.

It was found in this work that soft carbons, heat treated to 700°C, at room temperature have an absolute thermoelectric power Ⓗ of about +30 μv/K° , which, with increasing heat treatment temperature H, decreases to a minimum value of about -7 μv/K° at 1400°C, increases to a maximum of about +20 μv/K° at 2050°C, and decreases again to a limiting value of about -5 μv/K° above 3000°C. For 1400°C<H<1900°C, Ⓗ is proportional to absolute temperature T, while the position of $Ⓗ_{max}$, though insensitive to the presence of impurities, shifts with increasing T to lower values of H.

Hard carbons have a similar but less pronounced

dependence of Ⓗ on H than soft carbons. In addition a secondary Ⓗ maximum is found at about 2800°C. The Ⓗ vs. H curves for carbon blacks essentially overlap the soft carbon curves up to 1900°C, but then continue to rise to about twice $Ⓗ_{max}$. A leveling-off at very high H was observed for the larger carbon blacks. Pulverized carbons have a Ⓗ intermediate to solids and carbon blacks. An influence of chemisorbed gases on the value of Ⓗ is observed.

The maxima of the Ⓗ vs H curves occur for a value of H which on the R vs H curves of soft and of hard carbons correspond to a knee between a plateau-like region and a subsequent decline of R.

In addition to the X-ray analysis of soft carbons, which gave results in essential agreement with previous observations, it was found that a phenol-benzaldehyde (hard) coke graphitizes in two stages.

The behavior of soft carbons is explained in this work as follows:

The existence of the Ⓗ vs H maxima and the R vs H knees, as well as their temperature shifts, provides evidence for an electronic thermal activation energy, of which the magnitude decreases with increasing degree of graphitization. The small magnitude and linear temperature dependence of the thermoelectric power of baked carbons indicates a metallic behavior. These conclusions were found to be consistent with Mrozowski's energy band model, in which a decreasing energy gap and the presence of excess carriers are assumed. The sign reversal in baked carbons is interpreted to result from the dropping of the Fermi level relatively deep into the π-band. The anomalous high magnitude of Ⓗ observed for low T in highly graphitized carbons is believed to result from an effect that phonon currents have on the electronic distribution, as proposed by Gurevich and others.

The explanation of the two thermoelectric power maxima and two resistivity plateau-like regions followed by knees, found for hard carbons, follows from Mrozowski's model if their two phase crystalline structure and two stage graphitization is taken into consideration.

A model of the electronic structure of carbon blacks cannot be derived, based on the thermoelectric data above.

194 pages. $2.43. Mic 56-1543

THE EFFECTS OF PRESSURE ON THE ELECTRICAL PROPERTIES OF SEMICONDUCTORS

(Publication No. 16,337)

George Donald Long, Ph.D.
University of Pennsylvania, 1956

Supervisor: Park Hays Miller, Jr.

Measurements have been made of the effects of hydrostatic pressures between one and 2000 atmospheres on the electrical properties of several different semiconductors. The materials studied are germanium, indium antimonide, indium arsenide, gallium antimonide, tellurium, and magnesium stannide. It has been found that the temperature at which the Hall coefficient of p-type Ge reverses sign shifts to a higher value under the application of a pressure of 2000 atmospheres, and that the magnitude of the shift is in good agreement with the shift predicted by the known increase of the energy gap from one to 2000 atmospheres. The results of conductivity and Hall effect vs pressure measurements on InSb indicate that the energy gap increases with increasing pressure at a rate of 14×10^{-6} ev/atmos., and that the electron mobility is about 12 percent smaller at 2000 atmospheres than at atmospheric pressure. The transverse magnetoresistance of InSb is found to decrease slightly with increasing pressure in accordance with the decrease of electron mobility. Conductivity and Hall effect vs pressure measurements on extrinsic n-type samples of InAs and GaSb show that the electron mobility in InAs decreases by about 7 percent from one to 2000 atmospheres and that there is no such mobility change in GaSb. Conductivity and Hall effect vs pressure measurements on Te indicate that the energy gap is smaller by 0.032 ev at 2000 atmospheres than its value of about 0.336 at atmospheric pressure, and that the hole and electron mobilities increase with increasing pressure. A consistent scheme of interpretation of the results of the various pressure experiments on tellurium is proposed. Conductivity vs pressure measurements on Mg_2Sn show that the energy gap widens with increasing pressure by roughly 0.01 ev between one and 2000 atmospheres. Relations between the observed pressure effects and the energy band schemes of the semiconductors are discussed.

110 pages. $1.38. Mic 56-1544

SATURATION OF MICROWAVE PARAMAGNETIC RESONANCE AND RELAXATION EFFECTS AT LIQUID HELIUM TEMPERATURES

(Publication No. 16,194)

James Wagner Meyer, Ph.D.
The University of Wisconsin, 1955

Supervisor: Professor Ragnar Rollefson

Paramagnetic resonance experiments have been performed on nickel fluosilicate, nickel fluosilicate diluted with diamagnetic zinc, and the free radical α- α-diphenyl-β-picryl-hydrazyl, at 3 centimeters wavelength, and at temperatures in the 4.2°K to 1.3°K region.

The experimental method of observing the effect of high levels of microwave power on the resonance absorption and on the change in the component of magnetization along the static field is described. The results are presented.

An inverse first power dependence of the spin-lattice relaxation time on temperature has been established in the liquid helium region for nickel fluosilicate diluted with diamagnetic zinc. Using the theoretically expected variation of spin-spin relaxation time with dilutions for less than 10 per cent nickel concentration, it is shown that there is substantially no dependence of spin-lattice relaxation time on dilution.

Evidence pointing to a distortion of the lattice by the insertion of the zinc ion is obtained from the observed increased zero field splitting in the diluted salts, and the anticipated invariance of this splitting with temperature below 10°K has been verified.

The behavior of the free radical line width at low temperatures indicates a paramagnetic-antiferromagnetic transition near 1°K. Transient measurements on this organic compound indicate that the time associated with the transfer of energy between the spin system and the exchange energy acting as a reservoir is shorter than the resolution time of the apparatus ($\sim 10^{-7}$ sec.) at 4.2°K, but becomes observable, circa 10^{-6} sec., at 1.25°K.

The results are compared with available theories.

103 pages. $1.29. Mic 56-1545

PHOTOCONDUCTIVITY AND RECOMBINATION PROCESSES IN TELLURIUM

(Publication No. 16,342)

David Redfield, Ph.D.
University of Pennsylvania, 1956

Supervisor: Park H. Miller, Jr.

Recombination processes in tellurium have been investigated, chiefly by use of the techniques of photoconductivity. Studies were made on single crystals having acceptor densities of about 10^{16} per cm^3. The steady state photocurrent has been found to be insensitive to surface treatment at sample temperatures near 100° K. For these temperatures, the dependence of photocurrent on light intensity is linear for wavelengths longer than that corresponding to the absorption edge; but for shorter wavelengths this dependence shifts from linear at low light levels to square root at high levels. Analysis of the linear portion of this effect leads to an order of magnitude value for the low level lifetime of 5×10^{-5} seconds at 100° K. By using pulsed illumination the decay time constant of photocurrent was found to be 20 μ sec, in fairly good agreement with the above value.

The interpretation of the results of the various photoconductivity experiments leads to the conclusion that in Te at 100° K direct recombination dominates over recombination through localized centers (traps) at all light intensities. To explain this unusual result, it is proposed that as a rule, in small energy gap materials traps should be relatively ineffective as agents of recombination. It follows that small gap materials should have long lifetimes; thus they should usually be sensitive photoconductors. Furthermore, since the direct recombination probability increases as the gap becomes narrower, there should be some optimum value of energy gap (probably near 0.5 e. v.) that will give rise to the longest realizable lifetimes. Some confirming data on other materials is cited in support of this proposal.

An attempt to observe radiation which may be emitted in the recombination process was unsuccessful, possibly because of experimental limitations.

64 pages. $1.00. Mic 56-1546

PHYSICS, NUCLEAR

CORRELATED NEUTRONS AND PROTONS FROM THE HIGH ENERGY PHOTODISINTEGRATION OF LITHIUM†

(Publication No. 16,380)

Mark Quayle Barton, Ph.D.
University of Illinois, 1956

Systematics of the high energy photonuclear reaction in lithium have been studied using 285 Mev bremsstrahlung from the University of Illinois betatron. Photoprotons were observed and identified by means of a range telescope in which all of the absorbers were scintillators whose pulse heights were recorded by photographs of oscillograph traces. Photoneutrons in coincidence with the photoprotons were observed by means of a proton recoil counter. The counter equipment was calibrated using a deuterium target.

Data were taken giving the number of n-p coincidences as a function of the angle of the neutron counter for a fixed proton counter angle for four different proton energy groups.

The results are interpreted in terms of the Levinger* model with suitable modifications for the internal momentum of the nucleons inside the lithium nucleus and for the attenuation of the nucleons while escaping from the nucleus.

133 pages. $1.66. Mic 56-1547

†Supported in part by the ONR and the AEC.

*J. S. Levinger, Phys. Rev. 84, 43 (1951).

ANGULAR CORRELATION MEASUREMENTS IN THE DECAY OF HG^{197}

(Publication No. 16,319)

Horace Hunter Coburn, Ph.D.
University of Pennsylvania, 1956

Supervisor: Sherman Frankel

A brief review of the effects of perturbations on angular correlations is presented with some emphasis on Cd^{111} experiments. Reasons for continuing such investigations with Hg^{197} are given.

The effects of extranuclear fields on the angular correlation of Hg^{197} by measurements of electron-gamma and electron-electron correlations have been studied. The correlations observed exhibited attenuation factors of .47 $\pm$ .09, and were insensitive to the chemical environment of the source.

The interpretation made is that the fields of neighboring atoms can not account for the measured angular correlation. To further prove this hypothesis the angular correlation was measured as a function of time delay between the detection of the first and second radiation. The correlation thus obtained did not vary with increasing time delay (contrary to what one would expect from static field perturbations).

The conclusion drawn from these investigations is that the decrease in correlation is an effect due to the ionization of the atom following electron conversion in the first

transition. Since the L and M conversion data are consistent with the K conversion data for various compounds, the atomic states responsible for the perturbation are not the immediate K or L holes, whose lifetimes are quite short, but rather, excitations of higher atomic states. It is concluded that these perturbations are removed by the filling of the electron holes in less than 10^{-9} seconds.

Two possible mechanisms are discussed in more detail. One postulates a short lived excited atomic state with a strong interaction with the nuclear spin, I. The other possibility is a long-lived excited state also with a strong interaction. 70 pages. $1.00. Mic 56-1548

ELECTRIC EXCITATION OF Re, Ir, AND Hg ISOTOPES BY PROTONS

(Publication No. 16,155)

Robert Houser Davis, Ph.D.
The University of Wisconsin, 1955

Supervisor: Assistant Professor David A. Lind

Thick targets of natural and isotopically enriched rhenium, iridium, and mercury in the form of metallic and oxide powders have been bombarded with protons of energies up to 3.2 Mev. To analyze the composite gamma-ray spectra, the resolution, variation of Compton shape with gamma energy, and the efficiency of the scintillation spectrometer were determined by means of absolutely calibrated gamma-ray sources. Bombardment of Re isotopes produced gamma-rays at 125, 158, and 280 kev in Re^{185}, and at 135, 163, and 300 kev in Re^{187}. These lines were assumed to be electrically excited since the compound nucleus cross section is much smaller than the observed cross section. In Ir and Hg, agreement between the observed yield dependence on proton energy and that predicted by electric excitation theory for E2 transitions identified the following gamma-rays (in kev) as electrically excited: Ir^{191}, 115, 133, 216, 356; Ir^{193}, 143, 230, 368; Hg^{199}, 159, 209; Hg^{200}, 375. An additional electrically excited line from Hg at 425 kev was observed and was assumed to be the composite of 411 and 439 kev lines from Hg^{198} and Hg^{202}, respectively. Depending upon the complexity of the particular peak, the error in energy assignments varies from 1 to 3 percent while the estimated error in the excitation cross sections lies between 20 and 35 percent.

The collective nature of the excitations has been interpreted with the Bohr and Mottelson unified nuclear model. The deformation parameters evaluated from the cross sections have been compared with those determined from the excitation energy; the deformation seems to fit the systematic trend already established in this mass region. Where electric quadrupole moments have been spectroscopically determined or lifetimes directly observed, a comparison has been made with the values determined in this work. In Re and Ir isotopes, the electrically excited levels show a rotational character whereas in the even-even Hg isotopes such an interpretation was not possible. The levels in Hg^{199} have been treated as rotational although there is evidence that they are single particle levels. The presence of the 115 kev line belonging to Ir^{191} implies the existence of a level at this energy in addition to rotational levels at 133 and 356 kev.

84 pages. $1.05. Mic 56-1549

THERMODYNAMICS OF NUCLEAR MATTER

(Publication No. 15,495)

Paul Jesse Kellogg, Ph.D.
Cornell University, 1955

This work is an attempt to explain certain peculiarities of the energy level densities of nuclei. In the first section, after some attempt to sort out those experiments which reveal the nuclear level density, these peculiarities are discussed. It is believed that the process of coulomb excitation causes considerable complication in those experiments which involve the inelastic scattering of charged particles, but that experiments involving neutrons do give the level density. It is shown that it is difficult to understand the experiments except on the basis of a phase change in nuclear matter at an energy of about 8 MeV. The second section is devoted to calculating the connection between the statistical and thermodynamic properties for the simplest kind of phase transition, a first order transition in which the compressibility becomes infinite at the critical point. Then the transition energy of 8 MeV can be fitted only if one assumes a much softer nucleus than previously supposed. The incompressibility parameter, which is normally thought to be about 25 to 50 A MeV, must be taken to be about 20 A MeV for a light nucleus, and 10 A MeV for a heavy one. The third section is devoted to the question of whether such a soft nucleus is compatible with other evidence. No really definite evidence against the soft nucleus is found. The fourth section is devoted to the discussion of the thermodynamic functions above the transition in terms of a model which allows the one to connect the phase transition with properties of the level densities for the two phases and partition functions. It is shown that if the transition is of the type discussed here, then the second phase must be a gas, and must consist of the outgoing particles of the reaction. This implies breakdown of the compound nucleus theory for excitation energies greater than about 15 MeV.

56 pages. $1.00. Mic 56-1550

MASSES OF THE STABLE ISOTOPES OF CARBON, NITROGEN, OXYGEN, FLUORINE AND NEON

(Publication No. 15,937)

Maxwell Edward Kettner, Ph.D.
University of Minnesota, 1955

The masses of the stable isotopes of carbon, nitrogen, oxygen, fluorine and neon have been measured with a double-focusing mass spectrometer whose fields are stabilized by the use of an auxiliary spectrometer. Results of the measured doublets (in 10^{-3}amu) follow.

The measured values have been discussed and analyzed

$\frac{1}{2}C_4^{12}H_4O^{16}$-$O^{16}O^{18}$ = 19.040 ± 12

H_3O^{16}-HO^{18} = 11.405 ± 7.5, $\frac{1}{2}C_4^{12}H_2O^{16}$-$O^{16}O^{17}$ = 11.224 ± 9

H_3O^{16}-H_2O^{17} = 3.601 ± 6, $C^{13}H_4$-HO^{16} = 31.943 ± 12

$N^{14}H_3$-HO^{16} = 23.833 ± 9, $N^{15}H_3$-H_2O^{16} = 13.019 ± 6

H_2O^{18}-HF, = 8.582 ± 3, H_2O^{18}-Ne^{20} = 22.392 ± 6

$\frac{1}{2}C_2H_2O^{16}$-Ne^{21} = 11.429 ± 5, $\frac{1}{2}C^{12}O_2^{16}$-$Ne^{22}$ = 3.521 ± 10

by a comparison with mass values computed from nuclear reaction data and with values determined by other investigators. 75 pages. $1.00. Mic 56-1551

ALPHA PARTICLE EXCITATION OF NUCLEI

(Publication No. 16,480)

Raymond Ruther McLeod, Ph.D.
Purdue University, 1956

Major Professor: R. M. Steffen

An experimental study has been made of the excitation of nuclear isomers by alpha particles in the energy range from 7 to 20 Mev. The thick-target activation curve for excitation of the In^{115} isomer has been measured using scintillation spectrometry methods. The energy dependence of the cross section extracted from this data is not consistent with direct excitation of the isomeric state, but agrees with the theory of Alder and Winther assuming the excitation of one quadrupole level of approximately 1.5 Mev excitation energy, from which the isomeric state is reached by spontaneous decay processes. Using proportional counter methods, no evidence has yet been found of the excitation of the isomeric states of Sr^{87}, Rh^{103} and $Ag^{107,109}$. 104 pages. $1.30. Mic 56-1552

ISOTOPE SHIFT IN THE SECOND SPECTRUM OF TIN

(Publication No. 16,221)

John Allen Vreeland Sr., Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Julian Ellis Mack

Recent advances in the theory of nuclear shell structure have increased the contemporary significance of the nuclear ground state and the various parameters which describe it. One of the more important of the data relating to the ground state of the nucleus is the isotope shift in the optical spectra of elements with intermediate or large mass. The importance of the isotope shift is derived from its relation to such features of the nucleus as the radius and charge distribution.

In this investigation, the isotope shift in Sn II was measured. The techniques employed were those of conventional interferometric spectrometry except in the following respects: A static vacuum system was used instead of a system which circulates the carrier gas. A simple hollow cathode discharge tube was constructed with Kovar metal-to-glass seals instead of an alternative type of demountable seal. A stationary multiple cathode system with a moving spectrograph and optical bench was employed instead of a single cathode or a moving multiple cathode system. Separated isotopes were used. And finally, a novel method of reducing data from separated isotopes was devised.

The results for the three accessible lines in SnII which have a measurable isotope shift are tabulated below. Here

isotope / σ	Sn^{112}	Sn^{114}	(Sn^{115})	Sn^{116}	(Sn^{117})	Sn^{118}	(Sn^{119})	Sn^{120}	Sn^{122}	Sn^{124}
14506	0	4.5	5.6	8.8	9.8	12.6	13.6	16.4	19.0	22.0
15491	0	4.1	5.3	9.0	10.6	13.0	13.4	16.9	19.5	22.6
17239	0	28.0	36.0	54.5	61.6	78.3	82.6	100.0	120.1	136.9

the wave number, σ, is measured in kaysers (cm^{-1}) and the other quantities in the body of the table, which are shifts with respect to the Sn^{112} component, in millikaysers. In every case the shift is positive with an error of less than 1 mK. The isotopes in parentheses are represented in the table by the center of gravity of their hyperfine structure, as calculated from theoretical intensities and measured positions, rather than by a single measured position as are the others. 67 pages. $1.00. Mic 56-1553

BLOSSOM ABSCISSION IN DRY BEANS (PHASEOLUS VULGARIS, VAR. RED KIDNEY)

(Publication No. 15,580)

Ahmad Ali Ahmadi, Ph.D.
Cornell University, 1955

In the summer of 1951 and 1952 many of the New York State dry bean growers complained of reduction in yield caused by blossom and young pod drop. This problem has been most serious with limas and snap beans, but has also been observed in many other crops. Investigators have most frequently attributed blossom abscission in plants to high temperature, low relative humidity, and soil moisture deficiencies. Other factors which have been mentioned are carbohydrate-nitrogen ratio, light, wind, soil fertility and plant spacing. It has also been reported that blossom drop could be reduced by spraying or dusting the plant with a suitable growth regulator. Although the effect of environment and growth regulators on blossom drop in plants have been investigated for many years, little work has been done on the nature of blossom and young pod abscission in dry beans.

The objectives of this study were to investigate the nature of blossom abscission in dry beans (Phaseolus vulgaris, var. Red Kidney) and to study the plant response to environment, irrigation, fertilizer, and growth regulators.

During the three years period 1952-1955, four factorial experiments were conducted in the field and greenhouse. The chemicals involved in the experiments were N-meta-tolylphthalmic acid, para-chlorophenoxy acetic acid and orthochloropropionic acid. These chemicals were applied at different concentrations. The levels of nitrogen were twenty and forty pounds of ammonium nitrate per acre. The results can be summarized as follows. Twenty pounds of ammonium nitrate significantly increased the yield of Red Kidney beans in the 1953 field experiment. However, in the 1954 field experiment, nitrogen sidedressing did not affect the yield. The irrigation experiment showed that plants under high irrigation gave a 20% increase in yield over plants under low irrigation. In the greenhouse experiments high levels of nitrogen gave a significant increase in yield over plants receiving low level of nitrogen. The three chemicals did not affect the percentage of pod set but produced some parthenocarpy.

To study the effect of temperature on pollen grain germination and fertilization of bean flowers, two experiments were conducted in the greenhouse. Pollen grains were exposed to the following temperatures: 12, 15, 24, 26, 30 and 36°C. The optimum temperature for pollen grain germination was 15°C. and the critical temperature was at 30°C. In the next experiment, intact plants were placed under two temperatures: 90°F. and 70°F. The blossoms in the 90°F. house dropped while in the 70°F. house the blossoms remained attached to the plant. The anatomical studies showed that abscissed blossoms were not fertilized.

In conclusion, the cause of blossom abscission in dry beans under adverse conditions may be due to inability of pollen grain to germinate and resulting in abscission of blossoms and young pods. 61 pages. $1.00. Mic 56-1554

INTERACTIONS BETWEEN VITAMIN B_{12}, CORTISONE, INSULIN AND ALLOXAN DIABETES ON PROTEIN, CARBOHYDRATE AND VITAMIN B_{12} METABOLISM IN RATS

(Publication No. 14,445)

Yu-Sheng Louise Feng, Ph.D.
Michigan State University, 1954

1. When young rats were fed a vitamin B_{12}-deficient diet, supplementation with this vitamin increased appetite and body weight gains, slightly increased blood glucose, greatly increased glucose tolerance, but did not alter urinary nitrogen excretion. When one to four mg. of cortisone acetate daily were injected into vitamin B_{12}-deficient rats, there was a progressive increase in urinary nitrogen, increased hyperglycemia and glucosuria, decreased glucose tolerance, reduced body weight gains and decreased appetite. When 200 ug. of vitamin B_{12} per kilogram of diet was fed to cortisone-injected rats, and they were permitted to eat ad libitum, increases in urinary nitrogen losses were largely prevented, the hyperglycemia and glucosuria were reduced, glucose tolerance was increased and body growth was increased. Vitamin B_{12} was ineffective in these respects when food intake was restricted to that of animals receiving cortisone without vitamin B_{12}. It is concluded that large doses of vitamin B_{12} can partially counteract the protein catabolic actions of cortisone by increasing appetite, increasing the availability and utilization of carbohydrate by the organism and reducing gluconeogenesis from protein.

2. Large doses of cortisone partially interfered with the favorable action of vitamin B_{12} in increasing the efficiency of food utilization for body growth. This was accompanied by hyperglycemia and glucosuria, and was related to increased insulin resistance. Less carbohydrate was therefore left available for transformation into body weight gains (probably fat).

3. Alloxan-diabetes reduced body growth and the feed/gain ratio on the vitamin B_{12}-deficient but not on the vitamin B_{12}-adequate diet. In the latter rats there was much higher blood glucose, more urinary glucose, increased glucose tolerance but about the same urinary nitrogen losses as in the former animals. It is concluded that vitamin B_{12} can act independently of insulin insofar as its effects on glucose utilization and body growth are concerned.

4. Single injections of insulin (2 units in most cases) were much more effective in reducing blood glucose in normal, alloxan-diabetic and cortisone-treated rats on a vitamin B_{12}-adequate than on a vitamin B_{12}-deficient diet. This indicates that an ample supply of vitamin B_{12} is

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essential for maximum insulin action. By far the greatest resistance to insulin was found in the cortisone-treated rats on the vitamin B_{12}-deficient diet, confirming the findings that cortisone increases insulin resistance.

5. (a) Injections of large doses of cortisone (2 to 4 mg. daily) increased the urinary excretion of radioactive vitamin B_{12}, particularly in rats fed a vitamin B_{12}-deficient diet. On a diet meeting only normal requirements for vitamin B_{12} (20 ug./kilogram), cortisone did not increase urinary vitamin B_{12} until 4 mg. were injected daily. In general, the amounts of radioactive vitamin B_{12} lost in the urine were shown to be directly related to the dose of cortisone administered.

(b) Intraperitoneal injections of 750 mg. of glucose did not change urinary losses of vitamin B_{12} in alloxanized rats fed either a vitamin B_{12}-adequate or -deficient diet. Apparently blood glucose was already being used to the maximum extent possible in these rats.

(c) In normal and cortisone-treated rats on a vitamin B_{12}-adequate but not on a vitamin B_{12}-deficient diet, intraperitoneal injections of glucose decreased the loss of urinary vitamin B_{12}. This is believed to reflect greater glucose utilization in the former animals.

(d) Insulin injections (3 injections of 0.5 units each in 24 hours) greatly reduced urinary radioactive vitamin B_{12} losses in normal, alloxanized and cortisone-treated rats whether on a vitamin B_{12}-adequate or -deficient diet. This is believed to reflect greater glucose utilization in these animals. The decreases in urinary vitamin B_{12} were less on the vitamin-deficient diet, particularly in the cortisone-treated animals, and are believed to reflect the reduced effectiveness of insulin on glucose utilization in these rats. 128 pages. $1.60. Mic 56-1555

OBSERVATIONS ON THE BOVINE PITUITARY GLAND

(Publication No. 15,493)

Kenneth Vincent Jubb, Ph.D.
Cornell University, 1955

Sections from 350 selected bovine pituitary glands have been studied using the periodic acid-leucofuchsin staining technique. Aldehyde-fuchsin and, to a lesser extent, modifications of Mallory's connective tissue stain have been applied to duplicate sections for comparative purposes. By these method it has been found that cells staining by PAS include the basophils, many cells which are aniline blue chromophobes and some basophils of intermediate degrees of degranulation which are bigranulate by Heidenhain's azan method.

Cells containing granules stainable by PAS have been divided into beta and delta types on the basis of positional, morphological and functional differences.

The beta cells are large, polyangular, finely granulated and have an ill-defined cytoplasmic outline. They are concentrated in the medulla of the gland and occur sparsely scattered in the cortex. The functional relationships of the beta cells identify them with thyrotrophic hormone production. They become enlarged, degranulated and vacuolated in response to thyroxine deficiency.

By comparison with the beta cells, the delta cells are much smaller, rounded and sharply outlined and the granules are coarser and more irregular in size and shape. The delta cells are present in all parts of the adenohypophysis but are somewhat more concentrated in the medulla of the anterior lobe than elsewhere. In all situations they show a striking affinity for blood vessels.

The functional relationships of the delta cells identify them with gonadotrophic activity, especially luteinizing hormone release. Cyclic changes in rhythm with the oestral cycle are demonstrable in the delta cells of the anterior lobe proper - that is, excluding those in the pars tuberalis and zona tuberalis. Degranulation occurs in the anterior lobe proper during the first hours of oestrus, at a time when it is known that luteinizing hormone is released, and the process of degranulation is rapidly completed. Pituitary glands from cows which come into oestrus but fail to ovulate do not show this phase of delta cell degranulation.

The delta cells of the pars tuberalis and zona tuberalis do not undergo cyclic activity but are degranulated in "free-martins" and castrates. Qualitative assays performed on the pars tuberalis demonstrated the presence there of both follicle stimulating and luteinizing activities. The delta cells are the only granulated cells in the pars tuberalis and these presumably were the active fraction.

It has not been possible in this study to subdivide the acidophils. These cells discharge their granules at about the third day after oestrus and reach a peak of degranulation at about the tenth day after oestrus. Hypertrophy and other evidences of hyperactivity are present in the acidophils from the fourth to the eighth month of pregnancy. Hypergranulation of these cells is a feature of the hypophyses of cows with cystic ovaries, cows treated with parenteral oestrogens and genetic dwarf Herefords.
109 pages. $1.36. Mic 56-1556

STUDIES ON THE PATHOGENICITY OF CERTAIN INDUCED BIOCHEMICAL MUTANTS IN VENTURIA INAEQUALIS (CKE.) WINT.

(Publication No. 16,182)

David McKendree Kline, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor G. W. Keitt

Venturia inaequalis (Cke.) Wint., the incitant of apple scab, has been studied for a number of years in this laboratory by G. W. Keitt and co-workers. The continuing program of researches is concerned primarily with correlated studies of the genetics, nutrition, and pathogenicity of induced biochemical mutants of this fungus. Earlier studies indicated that nonpathogenicity was due to specific deficiencies since independently induced mimic mutants had the same pathogenic potential, and mutant progeny were like the mutant parent in pathogenicity. In the present study major attention was given to restoration of lost pathogenicity by supplying to representative mutants their required substances during incubation.

Pathogenicity of the choline, riboflavin, pyrimidine, arginine, lysine, and methionine mutants were restored by leaf-surface applications of their required substances; restoration varied from complete for the choline and

riboflavin mutants, to moderate for the pyrimidine, histidine, and methionine mutants, to partial for the arginine and lysine mutants. The lost pathogenicity of the adenine and the guanine mutants was not affected by like treatment.

The results with mimic mutants were in accord with the data obtained in trials with nine representative mutants with regard to loss and restoration of pathogenicity.

Conidia reisolated from sporulating lesions on supplemented leaves were deficient for the same required substances for which the original mutants were deficient.

The results from experiments on varying the time and number of applications of the required substances indicated that mutants continue to be dependent on the applied substances throughout the incubation period for full restoration of pathogenicity. However, more limited restoration was obtained by supplementing for periods ranging from one to ten days. This suggested that either mutants were able to obtain from the host a portion of their required substances or that a supply of the applied substances was stored in the fungus mycelium or in the host tissue or in both. It was shown that mutants may remain at the subcuticular infection site for a number of days in an arrested stage of development and then resume growth when supplemented.

Supplying the required substances from within the host tissue through the vascular system was effective in restoring pathogenicity to the choline and the histidine mutants, but was ineffective for four other mutants shown to respond to leaf-surface applications.

The pathogenicity of double mutant cultures was equivalent to that of the least pathogenic of the two mutants. Supplementing with either of the two required substances elicited a pathogenic reaction equal to that of the other mutant. When both deficiencies in the culture were associated with a reduction in pathogenicity, it was necessary to supplement with both required substances to restore pathogenicity.

The negative results from mixed spore inoculations indicated that the observed synergistic growth of unlike mutants in vitro was not operative in vivo.

While four pathogenic and four nonpathogenic mutants grew as well on apple leaf sap as on supplemented sap, three nonpathogenic mutants grew considerably less; yet only with the histidine mutant was the difference sufficient to account for lost pathogenicity. However, its growth on synthetic media suggests that amino acid inhibition rather than absence of histidine may be limiting.

These studies confirm earlier evidence that the nonpathogenicity of certain biochemical mutants can be attributed to their specific deficiencies. These mutants fail to establish a compatible parasitic relationship because of inability to proliferate without an external source of the required substances or to obtain from the host sufficient quantities to elicit full development. However, in most cases studied pathogenicity could be restored through applications of the required substances.

69 pages. $1.00. Mic 56-1557

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POLITICAL SCIENCE, GENERAL

PROBLEMS OF BRITISH AGRICULTURAL ADMINISTRATIVE LAW

(Publication No. 16,240)

Merlin DeWayne Gustafson, Ph.D.
The University of Nebraska, 1956

Adviser: Carl J. Schneider

In Great Britain there has been a long tradition of limited government as opposed to arbitrary and unlimited government. With the development of the welfare state there has developed the problem of restraining governmental authority at the same time government is given increased freedom to act decisively. It is the purpose of this study to examine the nature of the restraints placed upon the executive branch of government in the post-war agricultural program as well as the effectiveness of Parliament and the ordinary courts in maintaining control over administrative legislation and adjudication.

Most of the present agricultural policy was enacted in the Agriculture Act, 1947, and with a few amendments, the Act still outlines the main parts of the British agricultural program. Its purpose has been to promote and maintain a stable and efficient agricultural industry capable of producing as much of the nation's food as the national interest required. This objective was to be achieved by a system of guaranteed prices and assured markets, by enforcement of good estate management and good husbandry, by improvement of landlord-tenant relationships, and by provision of smallholdings for deserving tenants. The heaviest responsibility for enforcement of the Act was to fall upon the Minister of Agriculture; he was to be assisted by newly created administrative agencies.

County Agricultural Executive Committees were to be the key administrative agencies with the duty of requiring good estate management and good husbandry standards from all farm-owners and farmers. In order to carry out these functions, the Committees were granted quasi-legislative and quasi-judicial powers. Agricultural Land Tribunals were to be the key judicial agencies with the function of handling appeals from decisions of the Minister and the County Agricultural Executive Committees. Most of the Agricultural Land Tribunal cases were to involve appeals from dispossession orders and questions arising from landlord-tenant disputes. The Agricultural Land Commission was given the function of managing and farming land vested in the Minister, and it was also required to advise and assist the Minister in matters relating to the management of agricultural land. In carrying out these functions the Agricultural Land Commission would exercise legislative and judicial authority.

Although the legislative and judicial powers given to agricultural administrators have been quite extensive, many controls have also been enacted with these grants of authority. The common law courts have on several occasions reviewed the procedure of agricultural administration to see if there was conformity to the principles of natural justice. There have also been several cases involving ultra vires action. Parliament added an additional judicial control in 1954, when it provided for appeals from the Agricultural Land Tribunals to the High Court on questions of law. Parliament has retained a control over administrative legislation through numerous provisions for consultation, laying of drafts, publication, scrutiny by committee, and review in Parliament. These provisions seem to have been effective in preventing tendencies toward arbitrary administration.

There has been a sincere attempt to effectively control and publicize delegated legislation. Grants of discretionary power have in most cases been carefully defined. There has been an earnest attempt to make administrative tribunals conform to the principles of natural justice. Parliament and the ordinary courts do not appear to be losing an effective control over agricultural administrative legislation and adjudication.

268 pages. $3.35. Mic 56-1558

THE COMMUNISTS AND THE C.I.O.: A STUDY IN POLITICAL POWER

(Publication No. 15,979)

Max M. Kampelman, Ph.D.
University of Minnesota, 1952

American trade unions have in the main resorted to collective bargaining to achieve their aims, but their history is replete with instances of direct political activity as well. The depression and the birth of the Congress of Industrial Organizations in 1935 established a new dimension within the American labor movement, and brought with it a new problem of direct concern to a democratic society.

The vitality of industrial unionism, encouraged by the enthusiasm of the New Deal and the open endorsement of President Roosevelt, enlisted millions of people into the ranks of American trade unions. This development coincided with a change of policy and tactics on the part of the Communist Party. The Communist Party in the United States had been a frankly revolutionary party and its trade union tactics accordingly successfully isolated the Communists from the rest of the American labor movement. The Communist position began to change, however, after the rise of Hitler in Europe. By 1935 and 1936, the position of the world Communist movement was in the direction of a "united front" with liberals, socialists and labor union leaders. The new policy called for Communists to join the CIO and become influential in its counsels.

John L. Lewis, the first president of the CIO, believed that he could utilize the talents and energies of the Communists without losing control to them. Meanwhile, however,

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the Communists gained influence within the ranks of the national CIO staff and assumed leadership in a number of CIO international unions. Most of the leaders of the CIO were not Communists, but mistrusted criticism against Communist trade union leaders because of the fact that the term "Communist" was frequently applied indiscriminately to any militant trade union leader.

The issue of Communism within the CIO did not become important until the Soviet-Nazi Pact of 1939. It produced a sharp cleavage within the CIO and within the ranks of labor unions throughout the world, because Communist trade union leaders were impelled to use their union position to apologize for the Soviet Union.

The invasion of the Soviet Union by Hitler Germany brought about a sudden switch in the foreign policy of the Communist trade unions. From "isolationists" they became "interventionists". This sudden switch in political position which preceded Pearl Harbor by six months served further to help identify the Communist trade union leaders from those who were not. The entry of the United States into the war in December, 1941, however, helped to blur those distinctions. Even during this period, however, some tensions between the Communists and the anti-Communist camp within the CIO were noticeable and the Communist position of militant support for the war effort soon came to mean a decided lack of militancy with regard to traditional trade union demands.

The tensions that began to develop in 1945 between the United States and the Soviet Union reflected themselves in the CIO. Philip Murray, president of the CIO, was a warm champion of President Truman's foreign policy and lost no opportunity to make that clear. To carry out their foreign policy position, the Communist Party in and out of the CIO threw its support behind the candidacy of Henry Wallace for President on a Third Party ticket.

It became clear to the non-Communists and anti-Communists within the CIO that the national self-interest of the United States was at stake in the juggle for power that was taking place within their organization. This understanding was especially apparent in the field of international labor where the CIO found itself competing with Soviet led unions for the loyalty of European and Asiatic trade union members.

In 1948 and 1949 the CIO national office, under the leadership of Mr. Murray, took firm action against the Communists within the CIO by ousting all of the international unions under control of the Communist Party. In the international field, the CIO withdrew from the World Federation of Trade Unions and associated with the American Federation of Labor to form the International Confederation of Trade Unions.

The decision of the CIO to expel Communist led unions was not due to differences over trade union issues. It primarily reflected sharp differences over foreign policy and national self-interest. The Communists were adamant in their allegiance to the foreign policy of the Soviet Union. This inability to adjust their philosophy and tactics to the patriotic feelings of the American workers further separated the Communists from the main stream of American trade union life. 452 pages. $5.65. Mic 56-1559

FATHER COUGHLIN AND SOCIAL JUSTICE: A CASE STUDY OF A SOCIAL MOVEMENT

(Publication No. 16,193)

Nick Arthur Masters, Ph.D.
The University of Wisconsin, 1955

Supervisor: Professor David Fellman

One of the important political phenomena of the depression period was the Movement for Social Justice, sponsored and led by Father Charles E. Coughlin. During the 1930's this relatively unknown Roman Catholic priest rose to nationwide political prominence largely through the medium of the radio. Father Coughlin during the course of his radio career founded two organizations--the National Union for Social Justice and the Christian Front--and sponsored the Union Party, which nominated William Lemke, Nonpartisan League Republican from North Dakota, for the presidency. In the late 1930's the Movement for Social Justice espoused strong anti-Semitic and isolationist planks.

Stated as compendiously as possible, the purpose of this study was as follows: First, to describe this phenomenon; and second, to direct attention to the factors which contributed to its success and demise. Several hypotheses about politically-oriented social movements were formulated for the purpose of testing them by this one case.

The major section of this study is devoted to an examination of the ideology, leadership, organization, tactics, and third party attempt of the Movement. It was found that Father Coughlin dominated almost every phase of the Movement, and that what success it did have was directly attributable to his personal efforts. It was also found that the overwhelming majority of the supporters of the Movement were Roman Catholic. Furthermore, it was found that during the first phase of the Movement, from 1930 until the defeat of the Union Party in 1936, Father Coughlin received the support of prominent political figures of the period. During the second phase of the Movement, from 1937 until its demise in 1942, the priest and his followers were labeled as being pro-Nazi and pro-Fascist. Throughout the entire course of the Movement, prominent Roman Catholic dignitaries attacked Father Coughlin. Finally, it was found that the most noteworthy contribution the Movement made was that by its very existence there was demonstrated to the policy-makers of the times a wave of discontent.

The evidence available about the Movement for Social Justice adds weight to the support of four hypotheses about social movements in American politics. They are: (1) Social movements based mainly on analysis and criticism of the existing social order are short-lived and ineffective; (2) social movements must operate within the two-party system to endure; (3) social movements dominated by a single individual disintegrate when the leader no longer carries out his role; and (4) social movements that offend important and influential groups in society are short-lived and ineffective. It should be pointed out, however, that no attempt was made to prove that the hypotheses stated above are general laws of universal validity by an examination of the Movement for Social Justice.

335 pages. $4.19. Mic 56-1560

THE POLITICAL IDEAS OF BRIGHAM YOUNG

(Publication No. 16,441)

James Keith Melville, Ph.D.
University of Utah, 1956

Chairman: Dr. Frank H. Jonas

Supplied with the vitality of dynamic growth by Joseph Smith, distinguished by its theological tenets of modern-day revelation and a highly organized lay priesthood, The Church of Jesus Christ of Latter-day Saints grew as did none of the nineteenth century contemporary religions. Even though Mormonism was essentially a religious movement its scope was totalitarian. The ideas of the early Church leaders were not divorced from the contemporary economic, social, and political developments, but their uppermost consideration, religiously and politically, was a millenarian ideal, the Kingdom of God.

A struggle for control of the Church followed the assassination of Joseph Smith in 1844, out of which Brigham Young emerged supreme. During the succeeding thirty-three years he unified the Church, transplanted the Saints in the Great Basin, preserved their identity against a hostile nation and against the main currents of American social evolution in the nineteenth century, and stamped the Intermountain West as well as Mormonism with an unmistakable personal imprint.

His conception of man, his consideration of the nature of the state, his view of the Church vis a vis the state, and his economic teachings were enveloped within an all-inclusive religious system. The capstone of the politico-religious ideas of Brigham Young was the Kingdom of God. It remained throughout his life as an animating force for himself and for his people. His political ideas, though many were of a therapeutic nature and pragmatically provoked by daily contact with political problems, were the result of a conscious effort to establish the Kingdom of God as a world-state clothed with the garments of sovereignty. Christ would rule, yet provision was made for a representative legislature, and necessary administrative and judicial officers would be included; injustices would be eliminated; factional conflict and wars would cease; the fraudulent political systems would acknowledge the authority of the Kingdom; and ultimately this utopia would transcend the bounds of a sovereign world-state even, as it was to be a perfect society, a true civilization, as conceived by Brigham Young.

261 pages. $3.26. Mic 56-1561

NIGERIAN PLURAL SOCIETY: POLITICAL AND CONSTITUTIONAL DEVELOPMENT, 1870-1954

(Publication No. 16,291)

F. Oladipo Onipede, Ph.D.
Columbia University, 1956

Before 1914 the colonial political state known as Nigeria did not exist. Nonetheless, Anglo-Nigerian relations began as early as 1861. On that date, the United Kingdom began its consolidation of imperialistic enterprise in that region of West Africa, between the Bights of Benin and Biafra which later came to be known as Nigeria.

Part One of this study attempts to examine the concrete meaning of Pax Britannica in its pristine form -- as far as West Africa is concerned -- and the various stages of transformation that the idea itself underwent between 1870 and 1914. Some attention is given the fact that during the entire period (1870-1914), the attempt to give practical meaning and significance to the idea of Pax Britannica was given direction mainly by the colonial policy of the United Kingdom and the initiative of a few British colonial careerists. But from 1914 on, various extraneous forces like World War I, colonial nationalism, and the Great Depression of 1929-32, converged in part to force various reforms. Also the emergence of a westernized class of Nigerians and the impact of World War II further accentuated the need for colonial reforms.

Part Two examines the bases to these reforms. Thus, between 1914 and 1954, Nigeria had four various colonial constitutions -- in 1923, 1947, 1951, and 1954 respectively -- each one giving increasing participation in the political authority that determines the destiny of the nation. From 1914 to 1950 Nigeria had a unitary form of government. Consequently, all political authority was consolidated in the hands of the Colonial Governor. It was not until 1951 before a colonial federal form of government was introduced, and for the first time the tremendous plural nature of Nigerian society was given political significance. The immediate consequences of these events have been the emergence of and use of tribal nationalism for political action on the one hand, and, on the other, the demand to remedy the uneven economic development of the various regions of the country. Nigerian nationalism was thus forced to integrate the dominant indigenous institutional values into the concept of the "Nigerian." Because Nigeria has a horizontal pattern of plural society, the mainstream of the nationalist movement has tended to compromise the solidarity and unity of the country for regional diversity along linguistic-cultural lines.

However, the institutional transfer of political authority, i.e., the institution of colonial "representative government" has firmly taken root. Colonial "representative government" cannot become responsible until the objective of colonial nationalism is achieved, i.e., independence. For the realization of the latter, the articulate nationalist movement in the country has set a target date, 1956, and the official British Colonial Secretary's pronouncement has endorsed the target date after a tactical manner.

Here lies the crux of the problem of transformation, especially the cultural selective aspects that accompany the general process of westernization, the most important aspects of which are: the integration of parliamentary democracy into the life of Nigeria, socio-political enlightenment without which parliamentary democracy will become a farce, and, above all, the cultural selection taking place in the socio-economic aspects of the country's development. Can western technical know-how and skill be imparted into the Nigerian indigenous cultural life without disrupting it considerably? This question and similar ones are assessed in terms of the jural, moral, and fundamental principles sustaining African institutional bastions.

Lastly, the question as to whether Nigeria will become a dominion and an equal member in the Commonwealth of Nations is considered vis-a-vis Nigerian interests in West Africa, Africa and world politics.

409 pages. $5.11. Mic 56-1562

JAWAHARLAL NEHRU'S THOUGHT ON THE DEMOCRATIC STATE

(Publication No. 16,345)

Donald Eugene Smith, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Norman D. Palmer

The purpose of this study is to delineate as accurately as possible the ideas of Jawaharlal Nehru on some of the principal concepts and problems of democracy. In particular, the study deals with Nehru's thought regarding the nature of democracy, fundamental rights, economic democracy, and the secular state. The procedure adopted was to analyze the speeches and writings of Nehru in relation to the Indian political scene. A personal interview with Prime Minister Nehru served to clarify a number of points. Secondary source materials were helpful in providing different interpretations of Nehru's political thought.

Nehru's political thought was largely molded by his contacts with the West. His democratic ideas stem from the humanist liberal tradition of the nineteenth century. He was attracted to Fabian thought during his college days in England, but socialism made no lasting impact on his thinking until years later when he studied the writings of Marx and Lenin. Nehru is indebted to ancient and contemporary Indian thinkers for specific ideas and emphases, but the general framework of his ideas was derived from the West.

Nehru has defined the nature of democracy in four ways: in terms of individual freedom, representative political institutions, social and economic equality, and the self-discipline of the community. Democracy must be regarded as a complex conception, composed of diverse elements introduced historically at different periods. Certain problems, such as the conflict between freedom and equality, are thus inherent in the nature of democracy. Nehru has given considerable attention to these problems, and to others which arise out of modern conditions.

Nehru's basic approach to fundamental rights is that individual freedom is essential not only for the creative development of human personality, but for the progress of the state itself. Nevertheless, if the responsibilities of freedom are not accepted on the basis of self-discipline, society must impose discipline. Nehru has emphasized that the abstract ideas of European eighteenth-century theory would have to come to grips with the concrete problems of mid-twentieth century India. In particular, the right of personal liberty and the freedom of the press had to be reinterpreted in the light of Indian conditions.

By 1955 Nehru had greatly modified his earlier Marxist ideas, especially with respect to the clear-cut choice between socialism and capitalism, the class struggle, and the possibility of attaining socialism by democratic procedures. Nehru continued to stress the socialist goal of a society based on economic equality in which cooperative effort would replace the profit motive, but adopted a pragmatic approach to India's economic problems. A mixed economy, in which both private and public sectors could operate, promised to produce the results required.

Nehru regarded communalism, or the tendency to organize political life on the basis of religion, as the chief obstacle to the secular state in India. He regarded the secular state as the sine qua non of modern democratic practice, but in applying it to India had to deal with many problems unknown to Western political experience, such as communal electorates, communal civil codes, and the caste system.

One of the conclusions of the study regards the two characteristic emphases of Nehru's thought, namely, the dynamic nature of the modern world to which democratic theory must adjust, and the emphasis on conflict and balance as basic to the democratic process. The study has revealed little that could be termed original in Nehru's ideas. He has not produced a new synthesis of Western and Indian political theory. Nehru's distinctive contribution is that he has effectively interpreted, applied and adapted Western democratic principles to the political life of India.

351 pages. $4.39. Mic 56-1563

POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

UNRRA IN CHINA: A CASE STUDY IN FINANCIAL ASSISTANCE FOR ECONOMIC DEVELOPMENT (WITH EMPHASIS ON AGRICULTURAL PROGRAMS)

(Publication No. 16,269)

Irving Barnett, Ph.D.
Columbia University, 1955

After World War II the United Nations Relief and Rehabilitation Administration carried on a program in China which included some $520 million of supplies. Of these about half were classified as relief supplies, half as rehabilitation supplies. In actual practice a large percentage of the relief supplies were sold without regard to the relief objective for which they had been brought; the returns from sales were needed to finance the aid program. A large percentage of the rehabilitation supplies were actually used for development purposes. Thus the UNRRA China program provides an early precedent for other large-scale aid programs to underdeveloped countries, which have taken place or are projected in the post-war period. Besides the large-scale aid for development and rehabilitation (the experience with the aid given for rehabilitation is also useful for development programs), it included funds to help meet the internal costs of implementing the aid program (as has been said) and a large-scale technical assistance program. The emphasis in the study, however, is on those aspects of UNRRA's China experience which are relevant to a case study in financing of economic development.

The supplies classified as for rehabilitation were almost entirely for agriculture and industries. Well over half the industrial supplies were for transportation and communications.

There were a number of characteristics of the program and of the circumstances in which it was carried on which make it an especially useful precedent, particularly for programs in Asia, but also for most underdeveloped countries. China considered itself to have only recently emerged from semi-colonial status; the extra-territorial rights of the major powers had been relinquished only in 1943. There was a strong Communist movement in China

and a large area was under Communist control. The Communists after World War II were asking peaceful co-existence and in fact, a coalition government. The existence of the Communists and the civil war that was fought against them had a strong influence on many aspects of the total aid program. UNRRA attempted to operate in Communist-governed as well as Nationalist-governed areas. The National government had many administrative difficulties, one of the worst being the inflation which had been a difficult problem during the war and began again after the war was over. The government had also to cope with strong feudal elements in the country. The nation was disunited; ties to the central authority needed to be strengthened.

UNRRA's life span was too short for most of the projects undertaken to be carried to completion. A successor organization was appointed--the Board of Trustees for Rehabilitation Affairs--to carry on a number of the longer term projects. Its activities were cut short, however, by the advance of Communist troops in the civil war. It is not possible, then, to evaluate UNRRA's experience as a whole, since it was really incomplete. Therefore, emphasis is placed on a review of the individual projects that were undertaken, to consider what factors were influencing the progress of each of them. Because there were too many projects, the agricultural projects were selected for more detailed treatment.

It is impossible in as short a space as this to indicate the conclusions suggested by this study. Conclusions are offered in connection with the discussion of each project. In the last chapter, certain conclusions that the author wishes to emphasize are mentioned. They assume, based on the review of the program, that the supplies and the technical assistance were of a highly desirable order. Attention is then focussed on the nation itself, which is, after all, merely being assisted in a job which must primarily be its own responsibility. The aid cannot succeed if it is not used properly. The question is considered, what is demanded of the country undertaking development if it is to succeed in that objective, and if the resulting economy is to be of a desirable order. These demands include that the nation clarify its economic objectives and concentrate its efforts on achieving them; that it systematically plan the steps needed and be able to attract able, dedicated employees; that it base its program on democratic participation in government by its people, and that it carry on educational activities to prepare them for it.

357 pages. $4.46. Mic 56-1564

POLITICAL SCIENCE, PUBLIC ADMINISTRATION

THE PENNSYLVANIA PUBLIC SERVICE INSTITUTE—A STUDY OF STATE-ADMINISTERED IN-SERVICE TRAINING FOR LOCAL AND STATE GOVERNMENT

(Publication No. 16,321)

Thomas Joseph Davy, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Stephen B. Sweeney

The Public Service Institute trains officials and employees of local and state governments in the knowledge and skills required in their work. Since its establishment in the Department of Public Instruction in 1938 in response to the Federal George-Deen Act of 1936, it has trained over 115,000 persons; approximately 75 per cent of these have been firemen and policemen.

Objectives, Functions, and Relationships

Training is a function of command. The State's central training service should aim to establish the training function in or for the jurisdictions and agencies it services, and should assist them as the State's technical specialist.

The Institute's activities are oriented to the individual trainee in relation to his functional group. Its services are free. It has not adopted the position that it is the State's training specialist.

The Institute should:

1. Adopt as its fundamental principle the hypothesis that training is a function of command.
2. Limit its subvention to its clients to its technical services, and charge line authorities the costs of instruction.
3. Be the Commonwealth's technical expert on training.

Organization

The training service's administrative environment should facilitate accomplishment of its responsibilities. A representative committee should guide its activities. The unit should be so organized that it can continually know and be able to service efficiently all governmental jurisdictions.

Though its present location violates the principle of administrative homogeneity, there is no more appropriate location for the Institute. The Institute's Board has not viewed synoptically the Commonwealth's training problems. Its representation, staff organization, and emphases are functional.

The Institute should:

1. Have a more autonomous status within the Department of Public Instruction.
2. De-emphasize functional representation on the Board.
3. Centralize functionally for analysis of training needs, program planning, and research, and decentralize regionally for promotion, and class organization and supervision.

Determination of Training Needs and Priorities

The training unit should stress programs that most

directly strengthen public service; it should identify training needs, and establish priorities for servicing them.

The Institute provides training on request of any official, group, or jurisdiction.

It should:

1. Determine the Commonwealth's training needs and schedule priorities for servicing them.
2. Work only with and through a person or committee assigned responsibility for the training function by the jurisdiction being serviced.

Planning of Formal Training Programs

Program substance should be (1) based on position analysis, (2) planned as instructional units, and (3) the best available. Principles of learning should govern the planning of instructional units, preparation of aids, designation of methods, and class conduct.

Integrated "courses" characterize the Institute's program planning. It cannot keep its courses up-to-date. The Institute has not formulated the teaching principles applicable to its training.

The Institute should:

1. Plan instructional units through comprehensive position analysis.
2. Maximize participation of functional leadership.
3. Formulate a statement of learning principles for its staff and clientele.
4. Revise instructional units periodically according to schedule.
5. Itself designate training methods for each instructional unit.
6. Adopt standards for written instructional materials and require that trainees use designated materials.

Promotion, Supervision, and Evaluation of Training

Aggressive promotion of training should be a major activity of the State's training service. Quality of instruction is its responsibility: it should specify qualifications for instructors, devise training programs for them, and establish incentives for them. Completion of training should be certified to the trainee and his superior. The central unit should evaluate results and conduct research to improve techniques.

The Institute could exploit more fully its promotional opportunities. Only the Fire School qualifies instructors. There is no system for determining instructor's rates, building their prestige, nor evaluating their performance. Trainees receive certificates of completion. No systematic evaluation of training is made.

The Institute should:

1. Publicize by every possible means its objectives and programs and cooperation of line leadership.
2. Consider the qualification of instructors a major responsibility.
3. Grade certifications according to hours of training completed.
4. Evaluate training effectiveness, and conduct and encourage research.

380 pages. $4.75. Mic 56-1565

PSYCHOLOGY

PSYCHOLOGY, GENERAL

AN EXPERIMENTAL STUDY OF THE MECHANISM OF DENIAL

(Publication No. 16,314)

Bayard Badenhausen, Ph.D.
University of Pennsylvania, 1956

Supervisor: Francis W. Irwin

An experimental investigation was conducted to study the relationship between two psychological mechanisms, both of which involve falsification of fact, and memory. The mechanisms are lying and denying, and each is treated as involving distinguishably different patterns of behavior, although both have in common the aim of deception. The essence of the denial is self-deception, while that of the lie is the deception of others. The main hypothesis is that the relation between certain patterns of responses of liars and deniers (where such patterns fall on a continuum) and memory will be low-positive. The pattern of the deniers is highly selective and ego-related; that of the liars is more non-selective and task related. The final correlation is between the pattern of responses and amount of recall of the items involved in the experimental task.

Each of a group of 104 female undergraduate Ss was required to express her attitude of like or dislike for each one of a series of adjectives under conditions in which she was exposed only to the words themselves and could not construe their remote psychological import. Then upon the completion of Taylor's Manifest Anxiety Scale and the Lie Questions from the MMPI she again rated the same list of words, this time with the full but incorrect knowledge that they had been "previously chosen" by groups of known neurotic and normal college students similar to the subject herself. Then upon the suggestion that she had deliberately changed her responses this second time to agree with the "fictitious" but socially desirable standard, the subject was given the opportunity to assert or deny that she had in fact changed her attitude.

A test for the recall of the adjectives was administered on the supposition that denial breeds forgetting; lying, memory. Patterns of denying and lying were determined

by the use of contingency coefficients using the variable of denial admission in relation to the variable of the shifting of one's attitude. The rank order of these contingencies was correlated with the ranking of memory, and also with the anxiety and lie scores.

Since no significant correlations were found among the various contingencies and the memory scores, the original hypothesis was not confirmed.

39 pages. $1.00. Mic 56-1566

AN EXPERIMENTAL METHOD TO MEASURE INTELLECTUAL FUNCTIONING WITH VERBAL AND MOTOR FACTORS MINIMAL

(Publication No. 15,561)

Leonard Blank, Ph.D.
Moss L. Rawn, Ph.D.
New York University, 1955

The purpose of this study was to devise a method of objectively measuring perceptual and organizational processes relevant to intellectual functioning. These processes were defined operationally and the Method constructed according to the criteria thus imposed. An effort was made to keep verbal, motor, and cultural factors minimal.

Most measures of intelligence test for verbal or motor ability or both. Perceptual and organizational processes are relatively neglected and a distorted picture of intelligence is presented for Verbal and Motor Handicapped. There is a lack of objective measurements for the both Verbally and Motor Handicapped of which the Cerebral-Palsied make up a large part.

The Experimental Method was designed to measure objectively perceptual and organizational processes and thus help to provide a more comprehensive representation of intelligence with special application to handicapped persons.

The Method consisted of multiple-choice visual discrimination. The subjects assembled a male figure from among original pieces and alternates of subtle, moderate, and gross distortion but all of interchangeable fit. A practice figure was first demonstrated in pantomime and then 11 sets of 4 pieces each were presented in prescribed order. Subjects indicated their choice by touching a piece in some way. No verbal or motor responses were elicited and there was no time limit.

The test population consisted of 12, 14, and 16 year old males of dull, average, and bright intelligence. Included were students, Mental Defectives, Delinquents, and Cerebral-Palsied. The total sample was 193 subjects. The Method was administered individually to each subject and for each an estimate of intelligence was secured.

Analysis of Variance demonstrated that differences between mean Method score were not attributable to variability within the samples. The variables of age and intelligence were relatively independent of each other. Although differences between mean scores of subgroups were not statistically significant, trend differences were established. Intelligence and age were positively associated with Method score.

The following sample order emerged in every analysis: Normals scored highest; Delinquents, second; Cerebral-Palsied, third; and Mental Defectives, lowest.

Normals and Delinquents manifested a postive relationship of Method score with Wechsler Intelligence Scales. For both samples, highest correlations were with Full Scale IQ, second highest with Verbal, and lowest with Performance IQ. The Method did not correlate significantly with subtests involving visuo-motor coordination and speed factors. It appeared to measure less of these factors and probably more of a generalized intellectual factor and/or perceptuo-organizational processes.

When mean Method score was plotted against intelligence category, each sample manifested, and in the same fashion, increments with age.

Internal consistency of the Method and inter-tester reliability were established. However, reliability of administration was not significantly demonstrated when 14 individuals were re-tested one month after the original administration.

The Experimental Method appears to be a brief, efficient, and valid procedure for estimating intellectual functioning with minimal verbal, motor, and cultural factors present. This intellectual functioning seems to be largely composed of a generalized intellectual factor of which perceptuo-organizational processes are apparently an integral part.

There are implications for the applicability of the Method as an aid to gaining a more comprehensive evaluation of intelligence. Specific applicability is implied for verbal, motor, and verbal-motor handicapped (i.e., Cerebral-Palsied) as well as for action-oriented groups. Study of the comparative development of perceptuo-organizational processes between individuals of the same or different groups is suggested. These data ought to provide more effective educational and vocational planning. There is also some indication that the Method may prove useful in a battery of tests for the diagnosis of emotional difficulties or brain impairment. 194 pages. $2.43. Mic 56-1567

THE MEASUREMENT OF INDIVIDUAL PERFORMANCE IN SMALL DISCUSSION GROUPS

(Publication No. 14,452)

Donald Richard Bowlus, Ph.D.
The Ohio State University, 1955

A need has existed in an undergraduate course in educational psychology at The Ohio State University for the objective measurement of individual performance in the small discussion groups around which the course is organized. The present research concerned the development of a rating scale to meet this need. A statement of the hypothesis follows:

A. Individual differences in effectiveness in group performance exist and are measurable by means of peer forced-choice ratings.

1. The reliability of a forced-choice rating scale constructed to measure such performance can be demonstrated by its internal consistency and by agreement between multiple ratings.

2. The validity of this forced-choice scale can be

demonstrated by its correlation with external criteria of group performance.

Construction of the forced-choice rating scale consisted of six operations: (1) phrases describing various behaviors in the criterion situation were procured, (2) a 566-item, five-category check list was prepared from these phrases, (3) the check-list responses were analyzed to determine preference and discrimination indices, (4) a pool of forced-choice pairs was constructed from the check-list items, (5) the operation of the pairs was tested, and (6) preliminary forms of the forced-choice pairs were cross-validated.

The reliability was measured in terms of rater agreement and the internal consistency of the scale. Interrater reliability with four raters was .70. Internal consistency was estimated as .86.

The validation study was designed to accomplish two purposes: (1) to identify what the rating scale measures, and (2) to determine how well it measures the criterion. To this end, the rating scale and a number of variables considered relevant to the criterion were administered to a sample of 95 educational psychology students. The variables used consisted of (1) instructor and peer sociometric ratings of performance in the criterion situation, (2) personality and interest self-ratings, and (3) measures of achievement in the course and scholastic aptitude.

Intercorrelations among all measures were factor-analyzed by the Thurston multiple-group method, and the factors obtained were orthogonally rotated to meaningfulness. Five factors emerged from the analysis: Factor I - General Effectiveness in Group Work, Factor II - Friendliness, Factor III - Instructor Bias, Factor IV - Student Bias, and Factor V - Academic Aptitude.

The forced-choice rating scale had a high loading (.85) on the general effectiveness factor and no significant loadings on any of the other factors. This was interpreted to mean that the rating scale is a valid and objective measure of individual effectiveness in the educational psychology discussion groups.

In view of the evidence obtained regarding the reliability and validity of the forced-choice scale constructed in the present research, hypotheses A, A-1, and A-2 were all accepted. 76 pages. $1.00. Mic 56-1568

STUDIES IN GLASS BOTTLE SELECTION

(Publication No. 16,456)

Harold Germo Coe, Ph.D.
Purdue University, 1956

Major Professor: Joseph Tiffin

Glass bottle selection is the process of identifying, at the time of manufacture, the defect free bottles and packing those bottles so that they may be sent to the customer. Bottles containing defects should not be selected; they should be thrown into a "cullet can" and be reused in the making of new glass. Two types of errors in selection are recognized. These errors are: throwing away good glassware, and packing defective glassware.

The aim of these studies was to investigate some of the variables associated with glass bottle selection. Ball Brothers, Inc., at Muncie, Indiana, made available the facilities of their plant for these investigations. Four approaches to improving the quality of selection were considered. These approaches were: applicant screening, employee placement, employee training, and human engineering. The major part of this research has been concerned with or dependent upon the development of job sample tests.

Studies

1. A preliminary job sample test containing 144 half-pint whiskey bottles (five defect types and good bottles) was administered to 18 Purdue students. A simplified sequential analysis type of item analysis was used to identify the 96 most discriminating bottles. These 96 bottles constituted the first job sample test.
2. The 96 bottle test was administered to 65 Ball Brothers selectors. The reliabilities and per cent accuracies of the total score, of each defect, and of good bottles were determined.
3. Using the scores of selectors of the 96 bottle job sample as a criterion, the predictiveness of application blank information and Ortho-Rater scores was determined by expectancy analysis. Five categories in the application form were found to be predictive.
4. Four studies were conducted to compare the accuracy of selection resulting from various conditions at the selecting stations. Conditions present at the selecting stations at the plant were duplicated as much as possible. The major variable considered were the kind of background and the level of illumination. In all, 42 Purdue students were used as subjects. Bottles from the 96 bottle job sample were used. These investigations did not show that one set of conditions was significantly superior to all other sets of conditions.
5. A 288 bottle job sample test was developed and administered to 40 selectors at the plant. The reliabilities of the scores for all bottles, for all defective bottles, for good bottles, and for each of the defect types were determined. The standard errors of measurement for these scores were also determined. It is felt that this test is suitable for diagnosing training needs, for making job placements, and is suitable as a measurable task for human engineering research at the plant.
6. A cross validation was made of the application blank information that was found to be significant in study three cited above. The scores of the 40 selectors taking the 288 bottle job sample were used as the criterion. The results of study three were essentially substantiated.
7. An expectancy analysis of certain Ortho-Rater scores was made by comparing the best 75 per cent of these 40 selectors with the poorest 25 per cent of these 40 selectors. An acuity "profile" was found which differentiated these two groups. The scores of the selectors taking the 96 bottle test were used to cross validate this "profile".
8. A 144 bottle test was developed which is suitable as a screening test for non-experienced applicants. This test was administered to 13 female Ball Brothers employees who passed the acuity profile discussed in study

seven. The reliability and standard error of measurement for these scores is reported. The distribution of these 13 scores is also given. Recommendations for improving the accuracy of selection are given.

68 pages. $1.00. Mic 56-1569

AN INVESTIGATION OF THE EFFECT OF AN IRRELEVANT VARIABLE AND CERTAIN CULTURAL BIASES ON CONCEPT FORMATION

(Publication No. 16,443)

Harold Irwin Haas, Ph.D.
The University of Buffalo, 1956

The study combined an investigation of the effect of an irrelevant variable and certain cultural biases (prejudices) on concept formation. An irrelevant variable refers to an aspect of the stimuli which is systematically present but cannot be used to form the appropriate concepts. It was hypothesized that an irrelevant variable would make learning more difficult. The cultural biases refer to assumed prejudices about the intelligence of Negroes and whites and males and females. Groups were required to learn to assign response terms connoting intelligence to the stimuli in accord with or contrary to the assumed biases. It was hypothesized that it would be easier to learn in accord with than contrary to the prevailing biases.

In addition questions were asked regarding: (1.) the relationship between a measure of prejudice and learning certain of the concepts, (2.) the effect on learning of using simple and more complex response terms, (3.) the relationship of intelligence to the subjects' performance on the concept tasks, and (4.) the possibility of a difference in performance between male and female subjects.

The concepts were learned in an anticipation type learning task with positive reinforcement or correction given after every trial. The stimuli consisted of pictures in which racial color, sex, and arm position were systematically varied. A simpler two concept and more difficult four concept task were used. The response terms were either numbers or words implying degrees of intelligence. The subjects were 998 white college students from the University of Buffalo.

The following conclusions were reached. The effect of an irrelevant variable was not to make learning more difficult in any systematic manner as a simple complexity theory suggested. It could not be definitely determined whether the irrelevant variable had any other effect. The assumed cultural biases did not affect learning as was hypothesized. Some evidence was found for a positive relationship between prejudice as measured by the F Scale and difficulty in learning concepts involving Negroes and whites. The two kinds of response terms produced different degrees of difficulty in learning. This was attributed to differences in implicit set produced by the response terms which connoted degrees of intelligence. A small but consistent relationship between intelligence and performance on the concept formation tasks was found. Difficulty in learning was inversely related to level of intelligence. No general difference in the performance of male and female subjects was found. Pertinent questions about concept formation were raised and methodological considerations were pointed up.

125 pages. $1.56. Mic 56-1570

PERSONALITY MEASURES AS RELATED TO PERFORMANCE UNDER AUDITORY DISTRACTION

(Publication No. 16,376)

Horace T. Keller, Jr., Ed.D.
Temple University, 1956

The main objectives of this study were (1) to determine the effect of distraction upon the level and quality of performance, and (2) to determine the relationship between performance under distraction and the results obtained on certain measures of personality.

One hundred and twenty second-year technical institute students, all male, participated in this study. They were randomly assigned to four groups. The various experimental treatments were then randomly assigned to these groups.

There were two testing sessions. The procedure at the sessions was as follows:

Session I - All Groups

a. Three minute period on an extended version of the Digit Symbol Test of the Wechsler-Bellevue Adult Intelligence Scale, Form I.

b. Five minute period on the numerical operations section of the American Council on Education's Cooperative Commercial Arithmetic Test, Form U.

c. Guilford-Zimmerman Temperament Survey

d. Draw-A-Person Technique

Session II

a. Repeat of parts of "a" and "b" of Session I under the following conditions:

1. Control Group - normal conditions
2. Experimental Group A - subjected to music of the "progressive jazz" style
3. Experimental Group B - subjected to various unrelated noises
4. Experimental Group C - subjected to combined music and noise used with Experimental Groups A and B

b. Ten pictures of Thematic Apperception Test

c. Questionnaire given to Experimental Groups

Analysis of variance and chi square were the principal statistical techniques employed. The TAT results were treated qualitatively but all other measures were analyzed quantitatively.

The following represent the principal specific findings of the present study:

Distraction, in the form of unrelated noises and noises superimposed on music, had a highly significant effect upon the digit symbol performance.

There was a tendency for reduced accuracy on the arithmetic test under conditions of distraction.

The test-retest reliability of the digit symbol test was increased under distraction, that of the arithmetic test was decreased.

Distraction produced significantly different effects upon different individuals.

Individuals who were adversely affected by distraction on the arithmetic test were below average on such personality traits as restraint, emotional stability, and objectivity as measured by the Guilford-Zimmerman Temperament Survey.

Individuals who drew the female figure first in the Draw-A-Person technique showed a high degree of distractibility on the arithmetic test.

On the basis of the above and other findings the following general statements would appear to be justified:

The effect of distraction upon performance appears to depend in some measure upon familiarity with the task. The arithmetic problems, involving addition, subtraction, multiplication, and division were less susceptible to distraction than the unique digit symbol substitution which required more sustained attention.

Individual differences in degree of distractibility are highly significant. Individuals differ in their response to potentially distracting stimuli. The extent of the distraction on any particular individual will also depend upon the task in which he is involved.

Personality integration is related to distractibility. Those individuals who tend to react subjectively and show lack of restraint are more susceptible to distraction than those who display the characteristics of emotional stability.

102 pages. $1.28. Mic 56-1571

ECONOMICS AND THE NEXT GENERATION: AN INVESTIGATION OF THE KNOWLEDGE AND ATTITUDES OF HIGH SCHOOL YOUTH

(Publication No. 16,490)

Warren Frederick Seibert, Ph.D.
Purdue University, 1956

Major Professor: H. H. Remmers

This study was conducted to determine the relationships among thirteen knowledge, attitude, and personal data variables: Three measures of economic knowledge, two measures of economic attitudes, and the following personal data: grade in school, rural-urban place of residence, sex, region of the country, socio-economic status, political party preference, academic achievement, and educational level of attainment of the respondent's mother.

The 64 item questionnaire was completed by 3500 subjects, located in fifty secondary schools in 27 states. A representative, national sample of 2000 subjects was used in the majority of the analyses.

The statistical analysis of the data consisted of Pearson product-moment correlation coefficients among all possible combinations of the following variables: the three measures of economic knowledge, the two measures of economic attitudes, self-reported academic achievement, and education of respondent's mother. Five three-way classification analysis of variance problems were conducted, using the three measures of economic knowledge and the two measures of economic attitudes, in turn, as the dependent variable. The independent variables for these five problems were sex, grade in school, and rural-urban place of residence. Five additional analysis of variance problems made use of the same five dependent variables mentioned above but used political party, socio-economic status, and region of the country as the independent variables.

It is concluded that male tenth, eleventh, and twelfth grade students are generally superior to female tenth through twelfth grade students in economic knowledge. Males tend to be more conservative than females with respect to economic attitudes. Students from the East and Midwest are somewhat better versed in economic knowledge than are students from the Southern and Mountain-Pacific states. Republican students tend to be more conservative in their economic attitudes than their Democratic counterparts and to possess more economic knowledge than Democrats. Economic knowledge tends to increase with socio-economic status while economic attitudes tend to become more conservative with increases in socio-economic status. Economic knowledge increases with grade level and is correlated with academic achievement and mother's education. Students with more conservative economic attitudes tend to possess the greater amounts of economic knowledge.

Increases in grade level exert differential effects for rural students and urban students on some measures of economic knowledge and economic attitudes. Socio-economic status exerts differential effects upon students from the various regions of the country. Also, sex, grade level, and rural-urban status interact to produce effects beyond those obtained from an investigation of a single effect or from effects of two of the variables in combination. These interactions pose many problems which require additional investigation.

202 pages. $2.53. Mic 56-1572

THE EFFECTS OF VARIOUS MOTIVATIONAL CONDITIONS UPON LEARNING AND RETENTION

(Publication No. 15,658)

Lila Corkland Siegel, Ph.D.
State College of Washington, 1955

This investigation concerns the effects of four types of motivational conditions upon learning and retention of a list of paired-associates. The subjects (drawn from the fourth, fifth, and sixth grades) were divided into two major groups: M (massed) and D (distributed). Each of these major groups was subdivided into four subgroups on the basis of incentive administered after each learning trial. These subgroups were: P, praise; R, reproof; I, ignore; and C, control. Subgroups P and R were either praised or reproved prior to each trial, ostensibly on the basis of their performance on the previous trial. Subjects in incentive group I were present in the room while incentives were administered to P and R, but did themselves not receive any information about their performance on the last trial. Group C (isolation; no knowledge of results) was isolated from the other subgroups at all times.

The total investigation consisted of five learning trials with appropriate incentives followed by three retention trials without incentive. All learning trials for group M were separated by a period of three minutes, whereas the trials for group D were spaced twenty-four hours apart.

The time intervals between retention trials were uniform for all subjects: three hours, fifteen minutes between the fifth learning trial and the first retention trial; three days between the first and second retention trials; and six days between the second and third retention trials.

The analysis of variance technique was employed to determine the comparative effectiveness of the incentives for the total M and D groups regardless of level of ability or sex; for the M and D groups each dichotomized into "bright" and "dull" subgroups; and for the M and D groups each dichotomized on the basis of sex.

The relationships investigated are stated in the form of nineteen major null hypotheses which permitted comparisons of the effectiveness of the incentives within each of the experimental groups (e.g., massed males, distributed males, etc.); comparisons of the effectiveness of a single incentive (e.g., praise) for the dichotomized subgroups (e.g., males vs. females); and comparisons of the relative effectiveness of massed as opposed to distributed applications of incentives within each of the experimental groups.

Each of the nineteen hypotheses consists of three subsidiary hypotheses: one relating to the comparability of incentives for the learning trials (each recall test preceded by a presentation of the word-pairs); the second concerning the comparability of incentives for retention trials (recall tests without prior presentation of word-pairs); and the third concerning the comparability of incentives over all trials (learning and retention combined).

The results indicate that the null hypotheses are generally untenable. P and R tend to be more effective incentives for bright subjects than for dull subjects, and conversely, I and C are more effective for dull than for bright subjects. The results obtained for males parallel those obtained for bright subjects rather closely. However, the females respond to the incentives in unique fashion. When the incentives are distributed, they tend to be equally effective for females; when the incentives are massed, I, C (and, to a lesser extent, R) lead to more effective performance than P.

In addition, the incentives are not of comparable effectiveness when applied in massed and distributed fashion. Distributed applications of P uniformly lead to performance at a higher level than that obtained from massed applications of P. Although distribution of I generally causes greater retention than massed I, a comparable effect is apparent for the learning trials only in the case of the dull subgroup. Finally, distributed R leads to more effective learning than massed R for the bright subjects and male subjects, whereas this relationship is reversed for the dull and female subjects.

These results differ from those obtained by other investigators who were concerned with the comparative effects of incentives upon routine performance (e.g., arithmetic computations) rather than upon learning and retention. The conclusion which follows is that it is possible to generalize about the effectiveness of verbal incentives for learning and retention only with reference to such factors as sex of the subjects, level of ability of the subjects, and method of presentation of incentives (i.e., whether massed or distributed). 178 pages. $2.23. Mic 56-1573

PSYCHOLOGY, CLINICAL

THE EFFECT OF BILATERAL HIPPOCAMPAL STIMULATION ON THE ACQUISITION AND EXTINCTION OF AN INSTRUMENTAL RESPONSE*

(Publication No. 16,108)

Robert Eugene Correll, Ph.D.
State University of Iowa, 1956

Chairmen: Professor John R. Knott
Professor Walter R. Ingram

Electrical stimulation of the hippocampal formation has been reported to result in "attention-like" responses, circling movements and, at higher intensities, fear and defensive behavior, with electrographic seizures. No clear autonomic responses, or effects on learning, resulting from stimulation of the hippocampus have been demonstrated. The present study is concerned with the effects, in cats, of hippocampal stimulation at subseizure intensities on electrocortical activity, spontaneous somato-motor behavior, learning and performance of an instrumental (bar-press) response.

Bipolar electrodes were implanted ((chronically) bilaterally in the hippocampal formation. Transverse cortical electrodes were placed over the anterior portion of the middle suprasylvian gyrus. Electroencephalograms (EEGs) were run, and the electrical and behavioral effects of unilateral and bilateral stimulation determined. The cats were then trained to press a bar to receive a three gram meatball in an apparatus consisting of a starting box, a short runway and a goal box. A training series was carried out, six trials per day for seven days, followed by an extinction series. Animals were run on a twenty-four hour feeding schedule. Measures of running time (time between opening of starting door and end of runway, thirteen animals only) and response time (time between opening starting door and bar-press) for each trial, and the number of trials to extinction for one minute and two minute criteria were obtained, and transformed to feet per second.

Five unoperated cats were added to the learning study to make a total of thirty animals, divided into four groups. Two groups, including the five unoperated cats (N = 14), were never stimulated in the apparatus; one (N = 8) was stimulated at a just subseizure intensity during learning only; and the fourth (N = 8) was stimulated during both learning and extinction. Following the experiments, the animals were sacrificed and histological verification of electrode locations was made.

Sufficient stimulation of the dentate fascia and subicular regions of the hippocampal formation produced high voltage electrical after-discharge which seldom spread to the dorso-lateral cortex. Such stimulation produced seizures characterized by searching movements and staring, followed by arrest of spontaneous activity, and terminated with a series of cries and grooming behavior. No "emotional" activity of types reported by others was seen here, which may be related to differences in electrode placement or method of stimulation. Very rarely, motor seizures consisting of clonic jerking or wild running occurred.

Stimulation during learning had no significant effect upon response speed, within the limits of training, or on the number of responses to extinction, but did result in a

constant decrement in running speed. The group stimulated throughout extinction gave a greater mean number of responses to extinction for a two minute criterion but not for a one minute criterion. The results of this study support the following conclusions:

1. Subthreshold stimulation of the postero-ventral hippocampal formation seemed to result in an increment in the drive state of the animal capable of activating a learned response.
2. Subseizure hippocampal stimulation would seem to have an interfering effect, which may be inhibitory in nature, upon spontaneous somato-motor activity.
3. No interference with the functioning of the external sensory or proprioceptive systems results from subseizure postero-ventral hippocampal stimulation. Stimulation does not produce sensory cues, so far as could be judged within the limits of this study.
4. Within the limits of this study, stimulation of the postero-ventral hippocampal formation does not elicit a conditionable response with drive properties.
5. Electroencephalographic data indicate that the hippocampal formation probably acts through its effects on relay centers below the level of the dorsolateral cortex, and through its connections, direct or indirect, with the brain stem reticular formation.

93 pages. $1.16. Mic 56-1574

*This study was supported by a grant (M 675, C-2) from the National Institute of Mental Health, United States Public Health Service.

A STUDY OF DISTORTION IN EVALUATIONS OF OTHER PERSONS AS A FUNCTION OF PERSONALITY DISTURBANCE

(Publication No. 16,444)

Marvin L. Kaplan, Ph.D.
The University of Buffalo, 1956

The aims of this study were to test certain theoretical and applied concepts regarding the influence of pre-existing attitudes on evaluations of new stimulus persons. The influence of such attitudes was examined as a function of (a) personality disturbance, (b) type of stimulus person, and (c) attitudes held toward parents.

A group of 18 psychiatric ward patients was compared with a group of 18 nonpsychiatric patients who had been equated for age, intelligence, and education, but who had been selected so as to eliminate patients with past or present indications of personality disturbance. From a universe of items concerned with common personality conflicts a preliminary study selected a sample that was rated with consistent emphasis by individual subjects but with variability among subjects. In an attempt to eliminate the influence of rating sets related to the manner in which items are distributed, a forced-choice card sort rating technique was used that equated the form of the item distributions. All subjects made the following ratings: Mother, father, ward nurse, ward doctor, picture of a woman, picture of a man, wife, self, and self-ideal.

Three main postulates were drawn from theoretical bases and stated as predictions of results:

(a) Higher interjudge correlations would be obtained among the ratings made by the disturbed group.

(b) Higher relationships would be observed between the more disturbed subjects' ratings of parents and those of staff members, pictures, and wives.

(c) Less disturbed subjects would rate others as more similar to themselves.

The chief basis of checking these predictions was through intrajudge rating correlations. Various other analyses were carried out to test further theoretical implications and methodological issues. The main results were:

1. Normal subjects showed consistently higher relationships among almost all comparisons. Closer analysis indicated that the normals rated with a set of assumed similarity to self and assumed similarity to self-ideal that did not characterize the ratings of the psychiatric group. This set operated most strongly in the normals' ratings of parents.
2. Interjudge analyses revealed that these sets were shared among the normals in terms of the specific attributes that they assigned to themselves and others. The pervasiveness of these sets was measured by comparing interjudge ratings of the same and of different persons. It was found that the rating sets used by normals were so uniform as to almost completely obliterate differences between persons. However, some increment in agreement between subjects was noted when they rated the same persons and this was less true of more disturbed subjects.
3. Item analyses were made to determine the content of the characterizations of self, self-ideal, and parents made by the two groups. The normals made highly positive descriptions rating parents as consistently warm and supporting while the more disturbed group generally tended to introduce more negative qualities and qualifications of the "good" traits. Normals showed a higher correspondence between self and self-ideal and ascribed many more positive qualities to the self. Psychiatric subjects more readily ascribed unfavorable qualities to the self.

These results pointed out a significant aspect of the rating behavior of normals and suggest some need to revise current conceptions of normalcy. Normals cannot be characterized as being more accurate in perception; rather they seem to perceive others as like themselves. Furthermore, theoretical formulations that stress generalization and rigidity of attitudes as a function of degree of personality disturbance may require revision in terms of these findings. The notion that normals are more prone to identify with parents and others finds support in this study.

Several methodological leads that may facilitate further research in interpersonal perception were discussed.

142 pages. $1.78. Mic 56-1575

A STUDY OF THE PERCEPTION OF SELF AND OF OTHERS AS A FUNCTION OF GROUP EXPERIENCE

(Publication No. 16,185)

Carl Arthur Leuthold, Ph.D.
The University of Wisconsin, 1956

Supervisor: Assistant Professor Horace Allen Page

The self concept occupies a central position in Rogers' personality theory and in its application to client-centered therapy. The therapist endeavors to reach an "empathic understanding" of his client through achieving the client's own frame of reference. Studies have shown that clients in successful therapy demonstrate concurrent increases in attitudes of self acceptance and acceptance of others. It is important for theory and practice, particularly for group client-centered therapy, where the patient also plays the role of therapist, to inquire if his increasing accepting attitudes also reflect increasing empathic understanding of others. The more general question is whether empathic ability can be learned or effectively modified by manipulation of interpersonal relationships.

This study investigated changes in the self concept and in the perception of others' self attitudes as a function of two kinds of group experience. Small discussion groups of undergraduate college students enrolled in a psychology course were assigned to two kinds of treatment: a) a student-centered treatment following Rogerian principles and techniques of client-centered therapy and b) a teacher-centered treatment, representing an authoritarian, instructional approach. Participating in the experiment were 38 Ss, 23 females and 15 males, who were divided into four groups, two of which were assigned to each treatment. Groups assigned to treatments were equivalent with respect to sex ratio, academic status, academic record and major course of study. Before and after group experience each S described the self, the ideal self and the self attitudes of three others in the group by means of a Q-sort. S was asked to predict how the others would describe themselves. The three others described by S were selected by him as being persons with whom he felt respectively high, medium and low empathy. Empathy was defined for S as the ability to assume another person's frame of reference so as to see him as he sees himself. Predictions of the instructor and a randomly selected S were added to the final test battery.

Expectations derived from Rogerian theory were entertained for the Ss treated in a student-centered manner. It was predicted they would be differentiated from Ss in the teacher-centered groups by a) greater gains in empathic ability (prediction accuracy with the Q-sort), b) greater revision of initial perceptions of others and greater differentiation among others in predicting their self concepts, c) more accurate prediction of the instructor's self description and d) greater movement in ideal concepts toward the group mean ideal. An additional hypothesis was advanced that predictability and accuracy of prediction would be positively correlated irrespective of group treatment.

Two of five hypotheses were supported by the results: a) Ss receiving student-centered treatment were significantly more accurate in their predictions of the instructor's self description and b) good predictors were significantly better predicted. The three other hypotheses were not supported in the findings. Instead of confirming expected increasing differentiation in assessment of others, final measures demonstrated an overall movement, irrespective of group treatment, toward increasing similarity among all personality descriptions, whether of self or of others.

Increased resemblances among personality profiles are believed to be partly a function of repeated administrations of the Q-sort. An increasing tendency for S to assume similarity with the person he predicted contributed heavily to the observed increase in homogeneity of personality assessments by individual Ss and was a major source of variance among Ss in the measures obtained. Greater precision in measurement is needed to detect personality changes in the normal population sampled in this study than is required in similar studies with patients seeking psychotherapy. 185 pages. $2.31. Mic 56-1576

RETROACTIVE INHIBITION WITH AGGRESSIVE AND NON-AGGRESSIVE WORD LISTS IN NEUROTIC AND NORMAL SUBJECTS

(Publication No. 16,427)

Leon Soffer, Ph.D.
University of Illinois, 1956

This study was designed to investigate the hypotheses that 1) normal subjects will demonstrate less retroactive inhibition than neurotic subjects, 2) that less retroactive inhibition will be demonstrated for nonaggressive material than for aggressive material, and that 3) the most retroactive inhibition will occur under the conditions of neurotic subjects learning aggressive material. Thirty patients selected from a hospital population on the basis of a psychiatric diagnosis formed the neurotic sample. Thirty volunteers from veteran service organizations, screened by an initial interview, formed the normal sample. A traditional retroactive inhibition design with aggressive and non-aggressive word lists was used to produce experimental forgetting. Two dependent variables, recall inhibition score and savings inhibition score, were available for testing the experimental hypotheses. An independent estimate of anxiety was obtained from both groups by means of the abridged Taylor Scale of Manifest Anxiety. The mean Taylor scores indicated that a significant difference existed between the two groups with respect to the level of anxiety. Intelligence, age, and education were ruled out statistically through the use of the technique of analysis of variance, as decisive influences in performance. The experimental hypotheses were tested by means of a factorial analysis of variance design.

The recall inhibition score, when used as a measure of retroactive inhibition, showed no significant differences between the groups for any of the experimental conditions although the results were in the direction predicted. The savings retroactive score when used as a measure of retroactive inhibition indicated:

1) Normal subjects demonstrated significantly less retroactive inhibition (irrespective of the learning material) than did neurotic subjects.

2) Significantly less retroactive inhibition was demonstrated for subjects learning the non-aggressive

word lists than for subjects learning the aggressive word lists.

3) The greatest amount of retroactive inhibition was demonstrated for the neurotic subjects learning the aggressive word list. The differences between this group and the others were significant.

The results were discussed in relation to the "competition of response" theory of retroactive inhibition and with respect to the theoretical constructs developed by Hullian theorists. Furthermore, some uncontrolled variables were analyzed and eliminated as sources which might have served to confound the experimental results. The results themselves were considered as supporting the position that increased anxiety has drive functions which act as an impediment to memory functions.

76 pages. $1.00. Mic 56-1577

AN ANALYSIS OF THE CONTENT OF SEVENTEEN STANDARDIZED VOCATIONAL INTEREST INVENTORIES AND THE "VOCATIONAL INTEREST SURVEY"

(Publication No. 16,545)

Helen Gordon Stern, Ed.D.
Temple University, 1954

The main problem of this study was to analyze and evaluate materials used in the vocational interest testing field.

The need of such a study is emphasized in the professional literature which reveals differences in interpretations; poor correlation between items and occupations; unavailability of any statistical analysis of items; and the need to review prestige values accorded vocational interest items.

The procedure involved performance of a critical and statistical analysis of appropriate test items on seventeen standardized vocational interest inventories available at the Educational and Vocational Guidance Clinic of Temple University. Items were selected because of their codifiability, according to the "Dictionary of Occupational Titles," Parts I, II, III, or IV. Items were coded and classified into four categories, I. Names of Occupations; II. Occupational Activities; III. Courses of Study; and IV. Hobbies or Leisure-Time Activities.

Following codification, test items were analyzed in terms of major occupational groups and divisions and industrial designations. From the original 1240 analyzed items a representative vocational interest inventory of 300 items was derived, known as the "Vocational Interest Survey." This shortened inventory was evaluated for major occupational groups and divisions and industrial designations. The survey was administered to a selected population of 133 males, students at Temple University Community College and Technical Institute and findings were appraised for prestige accorded occupations.

Results of this study indicate:

1. A statistical analysis of items showed the greatest frequency distribution was within the category, Occupational Activities.
2. Distribution of items into major occupational groups and divisions is completely out of line, as compared with actual distribution of employees in any particular occupation.
3. Test developers did not build their items with special cognizance of the organization of the "Dictionary of Occupational Titles."
4. There was no direct correlation between rank of industrial designations and numbers of job-holders in a particular industry.
5. Greatest frequency scatter of items on the "Vocational Interest Survey" was in Occupational Activities.
6. Five different vocational interest inventories contributed 40 or more items of the final 300, comprising the "Vocational Interest Survey." They include Cleeton; Lee-Thorpe; Kuder; Roeber-Prideaux, C; and Guilford-Shneidman-Zimmerman.
7. There was no correlation between major occupational groups and divisions of the final 300 items and numbers of workers in those occupations.
8. Three categories of items analyzed according to entry classification showed 67 were among professional, technical or managerial occupations.
9. There was no positive correlation between ten highest ranked industrial designations of items on the "Vocational Interest Survey" and numbers employed in that industry.
10. Results of the test administration ranked the five highest occupational groups as professional, semi-professional, managerial and official, skilled, and semi-skilled, and the five highest prestige occupations as electrical engineer; electrical adjuster; physicist; aeronautical engineer; and radio repairman helper.

Conclusions from this study show:

1. Vocational interest inventories had items which were dissimilar as far as codifiability of items into four major categories was concerned.
2. Test developers did not distribute their items into major occupational groups and divisions according to census.
3. Developers of tests showed no cognizance of numbers of employed within a particular industry.
4. Test developers did not consider the internal construction of the "Dictionary of Occupational Titles" as a guide.
5. Lack of correlation between occupational groups and occupational job-holders, and between industrial designations and industrial job-holders applies to the analysis of all seventeen inventories and the derived inventory.
6. Five inventories contributed the most number of items, and five other tests the least number.
7. The 133 subjects gave the highest rank to professional and semi-professional groups of occupations. They attached the highest prestige to professional and skilled occupations and professional and kindred and electrical industries; and the least prestige to agricultural and service occupations and industrial designations.

173 pages. $2.16. Mic 56-1578

PSYCHOLOGY, EXPERIMENTAL

THE EFFECTS OF CONSTANT VERSUS VARIABLE APPROACH MOTIVATION ON HUMAN CONFLICT BEHAVIOR – A TEST OF MILLER'S HYPOTHESIS

(Publication No. 16,331)

Lawrence Katz, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Seymour Feshbach

Problem

There has recently been considerable attention focused on stimulus-response analyses of conflict behavior. It has been hypothesized that outcomes of approach-avoidance conflicts depend upon the kind of motivation involved in a particular conflict situation. The problems investigated in the present research concerned 1) the effect of stimulus-linked versus constant motivation on the steepness of approach and avoidance gradients, and 2) the effect of different loci of avoidance responses on such gradients.

Procedure

Subjects were 116 Army enlisted men and women. Thirty-six of these subjects were used in a preliminary study, which demonstrated that two sets of instructions, designed to produce constant and variable approach motivation, actually had these effects. The other 80 subjects were used in the main experiment. Apparatus consisted of five stylus mazes, forming a color and shape continuum, a stylus, and a variac. All Ss first had two trials on each of the two most dissimilar mazes (mazes A and E). Twenty-four Ss received shocks upon completion of maze E, and the other 56 Ss received shocks upon completion of maze A. Half of the latter Ss were given instructions establishing constant approach motivation for all mazes, and the other half were given instructions establishing variable approach motivation, with approach tendencies strongest for maze A. The 24 Ss shocked at maze E all received constant motivation instructions. All Ss were then asked to indicate their order of preference among four of the mazes, and were also asked to run one maze, which was assigned randomly.

Results

Following Neal Miller's detailed analysis of conflict and displacement situations, two hypotheses were formulated. Concerning the two groups shocked at maze A, it was predicted that the constant motivation group would show an increment in preference and speed over the variable motivation group, as the mazes became more dissimilar to maze A. Comparing the two constant motivation groups shocked at different ends of the continuum of mazes, it was predicted that the gradients of preference and speed would slope in opposite directions, with strongest net approach response strength shown at the point furthest from shock. Both these hypotheses were supported, using ranked preferences as a dependent variable. No significant differences were obtained using speed as a measure, but reasons were advanced for considering speed a probably inappropriate criterion in the present study. Efforts were made, in the design of the apparatus and through the instructions, to eliminate as far as possible the effects of verbally-mediated discriminations. From the reports of the subjects, it appeared that these efforts were, by and large, successful.

Conclusions

Evaluating all the results, it was concluded that the hypotheses were confirmed. Approach-avoidance conflicts have different outcomes, depending upon whether the approach motivation is constant or stimulus-linked. The phenomenon of displacement can be predicted from this finding. 44 pages. $1.00. Mic 56-1579

WITHDRAWAL OF A POSITIVE REINFORCER AND STRENGTH OF BEHAVIOR IN CHILDREN

(Publication No. 16,537)

Charles Lee Kogan, Ph.D.
University of Washington, 1956

This study was designed to compare withdrawal of a positive reinforcer with experimental extinction.

Fifty children from the housing project for married students and faculty at the University of Washington were assigned at random to five groups matched for mean age and for sex. Subjects were seen on four successive mornings. The experimental apparatus to which they were given access on these occasions was a device which was able to present and withdraw plastic trinkets contingent upon S's performance of a simple operant.

The following three groups were of prime interest: (SW) strong (9/10) withdrawal, (WW) weak (2/10) withdrawal and (E) extinction (no withdrawal). The two remaining groups; (LCO) long chain-oscillation and (SCO) short chain-oscillation were directed at evaluating the role of a possible reinforcing cue which entered the situation as an apparatus artifact.

Prior to the experimental treatments all groups were seen for two training periods which totaled 16 reinforcements at a fixed ratio (1:2). Subsequent to the treatments all groups received three five-minute extinction periods at one day intervals. Resistance to extinction was measured in terms of frequency of response.

S's behavior in the experimental situation was rated by a single concealed observer for general level of intensity during extinction.

Skinner's discussion of the functional properties of withdrawal of a positive reinforcer was interpreted as predicting a set of relationships between withdrawal and experimental extinction. The present results lead the writer to question Skinner's notion that these two operations, withdrawal and extinction, represent two clearly different processes. As an alternative, it was postulated that withdrawal may have either aversive or extinctive consequences, depending upon strength of the particular reinforcer. Both levels of withdrawal (SW and WW) result in significantly greater variability between subjects than is the case with extinction. This finding was discussed as a possible indication of greater relevance of withdrawal to personality differences.

The finding that the groups (LCO and SCO) which received chain-oscillation were more resistant to extinction than the remaining three suggests that this stimulus has

strong reinforcing properties. Possible explanations of the strength of this reinforcer were discussed.

The dependency of the treatment effects upon age level suggest that there are sharp differences in the capacity to discriminate brief stimuli between children 44 and 64 months of age.

There is only tentative evidence for response rate and level of behavioral intensity to vary with succeeding extinction periods. Intensity tends to rise as extinction proceeds, while response rate shows some indication of decreasing from the second to third period.

63 pages. $1.00. Mic 56-1580

THE DEVELOPMENT OF GROUP SCORES IN THE PREDICTION OF GROUP PERFORMANCE

(Publication No. 14,471)

Robert Edward Krug Jr., Ph.D.
The Ohio State University, 1955

This study was concerned with the following problem: (1) given a number of individuals who function as members of a group, where (2) the criterion performance can be evaluated meaningfully only as a group performance, and where (3) the human characteristics which are presumably relevant to the criterion performance are possessed by individuals and become known to us as measures of individuals, (4) we wish to combine these individual measures in a manner which will enable us to predict group performance.

The general hypothesis for the study was that the method of combining individual scores to form the optimum estimate of a group's future performance might be determined by logical deduction from the critical factors in the future performance, as these factors are revealed by job analysis. On the basis of the activity analyses of the four group performances employed in this study, eight specific hypotheses were advanced concerning the relationships which would prevail between a particular expression of group score and a particular criterion performance. In terms of these hypotheses, various types of group score were computed from the individual scores; thirty-three group scores resulted. There were twenty-two expressions of criterion performance available, based on the four activities.

The sixteen crews in the first sample were ranked on each of the fifty-five variables, and all intercorrelations were computed. The elimination of overlapping measures resulted in the selection of fifteen predictor variables and seven criteria. The correlations between these predictors and criteria provided the basis for testing each hypothesis.

The selected variables were then employed in a similar analysis for the second sample of sixteen crews, and identical tests were made. Differences between the results of the two samples were discussed, and tentative explanations were advanced.

The data permit the following conclusions.

1. Job analysis data provide information about the required group structure, and this information is useful in determining the nature of the scores to be taken as representing the group.
2. The score of the leader will be an adequate estimate of group performances characterized by a high degree of supervised individual activity.
3. The average amount of a relevant trait possessed by members of a group will estimate future performances characterized by a high degree of individual activity.
4. The average amount of a relevant trait possessed by members of a group will be a poor estimate of group performances in which the behaviors to which the trait refers must be coördinated with the behaviors of others in order to produce effective results.
5. In the absence of effective leadership, a measure of homogeneity of a trait among members of a group will predict performances characterized by a high degree of coördinated activity among group members.
6. Effective leadership serves as a force toward integration of behaviors among group members, compensating for the absence of trait homogeneity. In this sense, effective leadership is associated with a low difference between the scores of leader and sub-leader.

The following implications for research and practice were noted.

1. The rationale employed would appear equally applicable to studies investigating relationships between group structure and performance.
2. The relationship between population variables and structure seems analogous to the relationship between predictors and intermediate criteria, with syntality variables representing more distal criteria.
3. In view of these implications, a rather traditional psychometric approach to group performance should be feasible, since the problems involved seem familiar rather than unique.
4. For purposes of group assembly, the suggested relationships (i.e., leader and crew compensate for one another; leader and sub-leader do not) would seem worthy of additional investigation.

100 pages. $1.25. Mic 56-1581

EXTINCTION OF A RUNNING RESPONSE AS A FUNCTION OF THE SIZE OF A TUBE-RUNWAY

(Publication No. 15,671)

Robert Lloyd Martindale, Ph.D.
Michigan State University, 1955

The experiment was designed to test the possibility that a unique apparatus and procedure might provide a better framework in which to evaluate the implications of an interference theory of extinction. The apparatus was designed to provide a straightway running response that involved a far more limited set of variations in response than with the conventional straight alley. The extinction trials were much more widely spaced than in conventional procedures and this spacing was identical to the intertrial interval used during the acquisition trials.

The subjects were thirty experimentally naive albino rats. The apparatus was a glass tube straightway placed in an enclosure that provided a constant luminance without gradients within the tubes and end boxes. Three different tubes with internal diameters of 62, 72, and 82 millimeters were interchangeable in the enclosure.

The subjects were reduced 80 to 85 percent of their

ad libitum body weights during the experiment. They were also under 12 hour food deprivation for each experimental session. The subjects were trained to run to food reward through the 72 millimeter internal diameter tube with single trials spaced every 24 hours. This training phase lasted 15 days. One group of subjects was subsequently run in the apparatus every 24 hours for a period of 25 days with no food reward present. This group of subjects was divided into three subgroups during this phase. One subgroup ran through the 62 millimeter tube, one ran through the 72 millimeter tube, and the other ran through the 82 millimeter tube. The remaining subjects continued running to food reward to provide control groups in a balanced experimental design. Subsequent to this last phase all subjects were extinguished with massed non-rewarded trials.

The results showed no evidence of extinction under spaced trials unless the removal of reward was accompanied by a change in tube size. The data suggested the tentative conclusion that removal of reward in this situation was a far less important factor in producing experimental extinction, than other changes in the stimulus situation which required a modification in the performance of an acquired response. This result was considered consistent with an interference theory of extinction.

96 pages. $1.20. Mic 56-1582

AN EXPERIMENTAL INVESTIGATION OF THE RELATIONSHIP BETWEEN THE GEOMETRIC COMPONENTS AND SCALED JUDGMENTS OF AMBIGUOUS FIGURES

(Publication No. 15,500)

Edward Hays McAlister, Ph.D.
Cornell University, 1955

This study deals with the relationship between the geometric components of ambiguous or reversible figures, and scaled judgments of the relative two-dimensional or three-dimensional appearance of those figures. Two hypotheses were examined. The first hypothesis was constructed to parallel the Gestalt principles of good figure and maximum simplicity. The prediction following from these principles is that the best or most stable shape or organization of a figure should require less "information" for its complete specification than any other shape or organization.

The measures of stimulus "information" were ratio scores of weighted combinations of the geometric elements of the flat pattern or solid-appearing form represented by each stimulus figure, designed to maintain an inverse relationship between the complexity of a figure and the preferred response to that figure.

The combinations of geometric elements selected for this prediction scoring ratio were based on an empirical fit to preliminary data.

The response measures were categorical and rank-rating judgments of thirty-nine line-drawings along an instructed continuum of two-dimensionality to three-dimensionality. The correlation of .939 between the two resultant scales was significant past the .01 level of confidence. The hypothesis that these scale values would vary consistently with the prediction ratio scores was supported by correlations of .53, significant past the .01 level of confidence.

A second hypothesis was designed to control for judgments on a dimension of complexity not incorporated in the scoring ratio, by providing for separate analyses of figures of differing degrees of complexity. The estimates of average correlations derived from a z-transformation of the several correlations between the ratio scores and the judgments of figures separated for this analysis were significantly higher at the .05 point of confidence.

The ratio scores were then empirically fitted to the categorical judgment scale by modifying the elements in the scoring ratio. This fit yielded correlations significantly higher at the .06 and .005 points of confidence, under the conditions of the first and second hypotheses, respectively. These modified ratio scores were tested against the rank-rating scale; the resultant improvements in correlation were significant at the .08 and .0015 points of confidence, under the conditions of the first and second hypotheses.

The general conclusion was that an inverse relationship can be found between the dominant mode of appearance of an ambiguous figure and a combination of geometric elements describing that mode of appearance. This relationship is significantly improved when a control is placed on variance attributable to constant deviations in judgment from the instructed continuum.

101 pages. $1.26. Mic 56-1583

PROACTIVE AND RETROACTIVE EFFECTS OF ELECTROCONVULSIVE SHOCK ON APPROACH-AVOIDANCE CONFLICT

(Publication No. 16,421)

Bruno Paul Henry Poschel, Ph.D.
University of Illinois, 1956

An empirical investigation of the proactive and retroactive effects of electroconvulsive shock (ECS) on the behavior of albino rats in approach-avoidance conflict was conducted. The conflict was established in a runway with hunger serving as the approach drive, and conditioned fear serving as the avoidance drive. Three aspects of the behavior of the animals in the conflict situation served as indicants of the intensity of avoidance: latency of approach, number of vacillations, and distance of approach to the goal.

In conflict tests beginning ten days after ECS or after pseudo-ECS, it was demonstrated that the convulsive treatment (ECS) had a selective effect on the avoidance portion of the conflict. In terms of all three indicants of conflict, the avoidance behavior of the experimental animals was attenuated to a very marked degree. Moreover, ECS administered prior to fear conditioning reduced the intensity of the avoidance behavior to approximately the same degree as did ECS administered after fear conditioning. The proactive effects of ECS were as great as its retroactive effects.

These results suggest that an important therapeutic action of ECS is caused by prolonged physiological consequences of the treatment, rather than by the cerebral storm which occurs during a convulsion. In addition, the

proactive findings of the experiment indicate that the physiological consequences of ECS may have produced this effect by a genuine interference with emotional processes. Our findings were interpreted in terms of D. O. Hebb's theory which claims that the prolonged physiological consequences of ECS interfere with cortical activation of emotional disturbance by inducing hypersynchronous firing in large areas of the cerebrum. On the other hand, the theory proposed by G. T. Heistad and that proposed by R. W. Goy can not account for the proactive effects demonstrated in this study, since these theories claim that the physiological consequences of ECS increase the level of general emotionality of the organism.

Critical implications derived from Hebb's theory were discussed and compared with the findings of recent physiological and clinical studies of the electroencephalographic changes induced by ECS. It was shown that these implications concur with the findings of the independent empirical investigations. In addition, suggestions were offered to explain how Hebb's theory of ECS can account for other empirically revealed effects of ECS on emotional behavior, i.e., the reactivation of extinguished emotional reactions, sham rage phenomena, and conditioned fear to ECS procedure.

153 pages. $1.91. Mic 56-1584

A COMPARATIVE INVESTIGATION OF REPETITIVE BEHAVIOR

(Publication No. 16,346)

Walter Alvah Samuel Smith, Ph.D.
University of Pennsylvania, 1956

Supervisor: Eugene H. Galanter

The phenomenon of repetitive behavior (spontaneous alternation, behavioral variability, etc.) was re-evaluated to focus attention on the following aspects of the problem: (a) the terminal level of repetitive behavior (RB) after extended experience in a situation; and (b) the course of changes in such behavior. An hypothesis concerning the terminal level of RB was deduced from Glanzer's theory of Stimulus Satiation. On the basis of this deduction a terminal level of "chance repetition" was predicted. Hypotheses pertinent to the course of changes in RB were deduced from Glanzer and from Montgomery's Exploratory Drive position. Both theorists predicted that RB would increase as the number of trials increased, and that the form of the change would be a negatively accelerated curve.

Twenty-two male hooded rats were run 10 massed trials per day (one session) for a total of 30 days in a three arm radial maze. The animals had been deprived of food for 24 hours prior to each session. Food was available at each goal box on every trial. Latency and alley selection records were maintained.

A decrease in latency from 50 seconds as the mean value for session one to seven seconds for session 30 indicated that learning had occurred. Minimal change in between session repetition over the 30 sessions was evidenced. Within session mean repetition increased from 40 per cent at session one to 68 per cent at session 30. Analysis of the course of changes in RB revealed the development of two distinct modes; one at 20 per cent repetition and the other at 100 per cent. Individual animal repetition data is presented in support of the contention that subjects in each mode do not fluctuate between modes.

Early trial latency and repetition data was unsuccessfully applied to the problem of predicting which animals would fall into each mode. It was concluded that the variable accounting for this bimodality had not yet been tapped. The possibility that the experimental procedure produced this result was also noted. The relevance of a stochastic model to this situation was discussed.

In regard to the hypotheses, both Glanzer and Montgomery correctly predicted the negatively accelerated course of changes in RB. None of the theorists considered foresaw the splitting of the animals into two distinct subpopulations. Predictions of chance repetition as the terminal level of RB were not confirmed.

51 pages. $1.00. Mic 56-1585

PROBLEM-SOLVING AND PERCEPTUAL ORGANIZATION: THE RELATIONSHIP BETWEEN FLEXIBILITY-RIGIDITY IN INTELLECTUAL BEHAVIOR AND (a) FACILITY IN PERCEPTUAL CLOSURE AND (b) PERCEPTUAL ILLUSION. THE APPLICABILITY OF THESE MEASURES AS OBJECTIVE AIDS IN THE DIFFERENTIAL DIAGNOSIS OF MANICS, "NORMALS," AND DEPRESSIVES. HISTAMINE TOLERANCE IN RELATION TO THESE NOSOLOGICAL GROUPS AND INTELLECTUAL AND PERCEPTUAL PARAMETERS.

(Publication No. 12,239)

Monroe Stein, Ph.D.
New York University, 1955

The purpose of the study was to investigate flexibility-rigidity of problem-solving set on the one hand and facility in closure and susceptibility to illusion on the other as parameters on the complex level of thinking and the more basic level of perception respectively. In determining the relationship between problem-solving and perception as complex and more primitive levels of behavior respectively, the study investigated one aspect of the theory that perceptual processes reflect personality and other characteristic molar behavior patterns.

In addition, the purpose of the investigation was to determine whether the tests employed in the study could be useful as objective aids in the differential diagnosis of "manic," "normal," and "depressive" conditions. Possible significant covariation of flexibility-rigidity in specific cognitive and perceptual behavior with chronological age and histamine tolerance as a physico-chemical concomitant of behavior was explored. Also, possible significant differences between young and old pathological groups and different pathological groups of the same age range in terms of histamine tolerance was explored.

Three sample groups of 20 subjects each, consisting of "manic," "normal," and "depressed" male and female individuals between 19 and 35 years of age, and two additional sample groups of 20 subjects each, consisting of "normals" and "depressives" between 40 and 65 years, were used. A modification in test form of Luchins' water jar problems, the Mooney Closure Test, and the

Poggendorff Illusion Test were used to measure the problem-solving, closure, and illusion functions respectively. The Steinman scoring method was used to quantify the Human Figure Drawings as an indirect index of histamine tolerance.

The results suggest the following conclusions:

1. Facility in closure parallels significantly flexibility-rigidity in problem-solving in "normal" and "manic" groups separately and combined. There seems to be a slight correspondence between problem-solving rigidity and susceptibility to illusion in pathological groups which is revealed when the sample population is very large. No significant correspondence between problem-solving and closure was found in "depressives."

2. The Modified Luchins Procedure and the Mooney Closure Tests are useful as aids in differentiating "normals" from severe affective disorders, but fail to differentiate among affective disturbances. The Poggendorff Illusion Test was found to be of no value as an objective aid in differential diagnosis.

3. Rigidity in problem-solving and closure was found to increase significantly with chronological age in "normals," but no change in susceptibility to illusion was found.

4. No significant difference in histamine tolerance between any of the "normal" and/or pathological groups nor any significant parallel with the perceptual or problem-solving parameters was found. This finding, however, should be accepted with considerable caution because of the observed discrepancy between clinical assessment of intensity of pathology and the Steinman scoring method.

5. Problem-solving and perceptual behavior was found to become increasingly rigid with chronological age. Susceptibility to illusion was not found to be an increasing function of chronological age.

The inadequacy of the method of measuring histamine tolerance as a possible physiological correlate of problem-solving set and perceptual behavior in this study leaves this relationship an interesting problem for further investigation. In general, considerable consistency in rigid behavior on basic and higher levels of functioning was demonstrated despite the tendency toward disharmony produced by pathological affective conditions.

134 pages. $1.68. Mic 56-1586

SECONDARY MECHANISMS IN THE CONTROL OF BEHAVIOR: RESPONSE SELECTION IN THE ABSENCE OF PRIMARY DRIVE AND PRIMARY REWARD

(Publication No. 16,431)

Albert Marvin Swanson, Ph.D.
University of Illinois, 1956

An experiment was designed to determine whether a secondary drive and a secondary reward, both established within the context of a deprivation-reward cycle involving hunger and food, could be employed conjointly to influence response selection by albino rats.

Four groups of 12 rats each were placed on a daily motive cycle, involving 23 hours of food privation and 1 hour of feeding, for a period of twelve days. During this period two types of training were administered. Drive conditioning: each subject was placed in a distinctive compartment 1 hour per day for drive conditioning. Two groups (weak-drive groups) were in the drive-conditioning compartments during the 2nd hour of food privation. The other two groups (strong-drive groups) were in the drive-conditioning compartments during the 22nd hour of food privation. The cues in the drive-conditioning compartments were expected to acquire motivating properties for the strong-drive subjects by contiguity with emotional reactions presumed to be associated with intense hunger. Those cues were expected to remain relatively neutral for the weak-drive subjects. Secondary-reward training: in addition to drive conditioning each animal received 20 trials every other day, or a total of 120 trials, in another apparatus where a 2 sec., 530 cycle tone was paired with immediate presentation of food (.3 grams) under 23 hours of food privation. This training was intended to establish the tone as a secondary reward.

After the completion of training all subjects were allowed 36 hours with free access to food in their living cages to recover from the deprivation cycle. Then each subject was tested for ten minutes in the drive-conditioning apparatus with a Skinner-bar present. One strong-drive group and one weak-drive group were tested with a bar that produced the 530 cycle tone as long as the bar was held down a distance of 5mm. The remaining strong-drive group and the remaining weak-drive group were tested without reinforcement of the bar-pressing response by the tone.

The bar-pressing activity of each group after training was compared with an unconditioned level of performance determined in a preliminary test trial before training. The strong-drive group tested without secondary reinforcement by the tone and the two weak-drive groups showed little change in performance after training. The strong-drive group tested with secondary reinforcement, however, showed a significant increase in duration of bar-pressing activity, responding three times as much after training as they did before training.

The results indicate that stimuli repeatedly paired with intense hunger can acquire secondary motivating properties which promote the selection of a response that produces a secondary reward, repeatedly associated with hunger reduction. The results appear to favor the conception of secondary motivation and secondary reinforcement proposed by O. H. Mowrer.[1]

58 pages. $1.00. Mic 56-1587

1. Mowrer, O. H. Two-factor learning theory reconsidered with special reference to secondary reinforcement and the concept of habit. Psychol. Rev., 1956, (In press.)

PERSISTENCE OF A CONDITIONED RESPONSE IN TWO-YEAR-OLD CHILDREN AS A FUNCTION OF THEIR BIRTH WEIGHT AND THE REINFORCEMENT SCHEDULE DURING ACQUISITION

(Publication No. 16,300)

Wilma Wilson, Ph.D.
Tulane University, 1956

Chairman: E. Lee Hoffman

This study was designed primarily to test with two-year-old subjects the hypothesis that partial reinforcement in acquisition increases resistance to extinction. Children 20 to 31 months of age were used in order to minimize the relatively patterned behavior acquired by humans as a function of language and other socialization processes. The subjects used included premature and full-term children, as defined by weight at birth. This made possible a comparison of the effects of partial reinforcement on the different birth-weight groups. Therefore, the hypothesis stated that partial reinforcement increases resistance to extinction, within premature and full-term groups as a function of the experimental conditions, and between premature and full-term groups as a function of experience prior to the experiment proper.

Subjects were divided into three groups on the basis of weight at birth. Group A contained 27 subjects who had averaged 2 lb. 11 oz. at birth, Group B contained 27 subjects who had averaged 4 lb. 1 oz. (both premature), and Group C contained 25 subjects who had averaged 7 lb. 4 oz. at birth (full-term): a total of 79.

A Skinner-type apparatus similar to one designed by Bijou was used. The response required of the subject was one expected on the basis of Gesell's findings to be in the repertory of infants 12 months or older: releasing an object into a receptacle. Dropping a ball into the Bijou box was reinforced with candy.

Acquisition consisted of ten trials spaced at four-second intervals; extinction followed immediately and consisted of a five-minute period in which, except for the four-second intertrial interval, subjects were free to respond at their own rates. A 2 x 3 factorial design was used in which each of the three birth weight groups was divided into a continuous (100%) and a partial (60%) reinforcement subgroup.

Statistical analysis of acquisition data indicated that the premature children took significantly longer to complete the ten acquisition trials than did full-term subjects.

The measure used for analysis of extinction data was the number of responses made in a five-minute interval following acquisition. Analysis of variance of these data indicated that there were no significant differences between partial and continuous reinforcement groups, or between birth-weight groups in extinction. The interaction between weight groups and reinforcement schedules was not statistically significant, indicating that the birth-weight groups were not differentially affected by partial reinforcement.

One factor in the failure to support the hypothesis may have been the lack of sufficient cues for discriminating between reinforced and nonreinforced trials. The procedure in this and other studies using the Bijou box allows reinforcements to accumulate in view of the subject. Discrimination between rewarded and nonrewarded trials depends upon the subject's seeing or hearing the reinforcement drop into a receptacle. As acquisition progresses, this receptacle becomes full, and visual and auditory cues are less pronounced. It is suggested, therefore, that the reinforcement be removed from view before each new trial in order to increase the discriminative cues, and thus the differentiation between reinforced and nonreinforced trials.

Although the differences were not statistically significant, prematures proved more susceptible to persistence training with partial reinforcement than did full-term children. These trends are seen here as supporting Skinner's as well as Maslow's theory of frustration tolerance. These theories state that persistence training, or frustration tolerance, is best effected with partial reinforcement schedules introduced after an initial period of continuous reinforcement. Prematures, because of their physical frailness, are regarded here as that group most likely to have received consistent reinforcement in infancy, and therefore would be expected to be more persistent in the absence of reinforcement than full-term children after training with partial reinforcement.

The increase in number of responses with the increase in weight at birth, the significantly longer time required by prematures to complete acquisition, and the poorer motor coordination as measured by number of subjects who missed the hole with the ball, were seen as supporting the findings of previous studies regarding the slower rate of development of premature infants.

57 pages. $1.00. Mic 56-1588

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

A STUDY OF ALBERT SCHWEITZER'S THEORY OF RELIGIOUS EXPERIENCE: AN ANALYSIS OF THE BASIC CATEGORIES OF A THEORY OF RELIGIOUS EXPERIENCE OF ALBERT SCHWEITZER

(Publication No. 12,203)

Margery May Chan, Ph.D.
New York University, 1954

The Problem

The purpose in this investigation was to analyze the basic categories of a theory of religious experience contained in the writings of Albert Schweitzer. The basic categories of a theory of religious experience were defined. Albert Schweitzer's theory of religious experience was identified. It was compared with those of the five outstanding contributors to the field, James, Coe, Pratt, the Wiemans, and Boisen. The original contributions to a theory of religious experience of the writings of Schweitzer were determined.

The Need for the Study

In recent years the contributions of Albert Schweitzer in the fields of music, theology, philosophy, and medical missions have been receiving more and more attention from the general public. The philosophy of Reverence for Life has definite psychological significance and is based on a new approach to psychology of religion.

The Historical and Theoretical Background of the Problem

The publication of William James' Varieties of Religious Experience in 1902 started a flood of literature attempting to explain in psychological terms the religious behavior of mystics, converts, prophets, and just ordinary churchfolk. Peculiarly an American movement, the psychologizing of religion spread to Germany, France, and England and directed theological thinking into psychological rather than philosophical channels. Since the second World War the field has been somewhat restricted to practical applications to the problems of pastoral psychology and religious counseling.

The present investigation was focussed on the contributions of Albert Schweitzer to the field.

The Results

Albert Schweitzer contributes a new emphasis on perception in religious experience. He does not seek absolute or final knowledge of God, man, Jesus, the world, or life. On the other hand he does not seek ecstatical emotional experiences of sacred realities. Instead he presents religious experience as a set to perceive all life as sacred, our own life in dynamic relation to all other life, and our own happiness as a sacrifice on the altar of life.

Suggested Applications

In the religious education of childhood and youth, religious appreciations rather than rational explanations should be emphasized. The arts should be used more than they are in Protestant religious education. In youth, Christian idealism should be emphasized and retained as the young person develops in maturity. These are the recommendations of applied religious psychology based on Reverence for Life.

174 pages. $2.18. Mic 56-1589

SOCIAL PSYCHOLOGY

A STUDY OF NEGRO-WHITE MARRIAGES IN THE PHILADELPHIA AREA

(Publication No. 16,371)

Eugene Cash, Jr., Ed.D.
Temple University, 1956

The Problem

The present investigation was undertaken (1) to determine the nature of the social adjustment experienced by the group under study; (2) to determine the nature of the interpersonal adjustments required in these unions; and (3) to determine the stages through which the Negro and white partners passed in an attempt to reach the desired degree of racial acceptance presupposed by the union.

Procedure

Answers to the above questions were secured primarily through two devices, a marriage inventory and tape recording of the investigator's interviews with the thirty-four partners under investigation.

Findings

Among the more important specific findings, the following may be enumerated:

1. In three out of every four unions the male partner is Negro and the female partner is white.
2. The range in age of the females was twenty-one to sixty-five years and for the males, twenty-six to sixty-six years, while the females averaged thirty-five years and the males forty years.

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3. The range in the number of years married for the couples involved was from one to eight years with an average of five years.

4. Sixty-five percent of the males and fifty-three percent of the females had been previously married.

5. Fifty-three percent were home owners.

6. The educational background of the individuals studied averaged four years of secondary education and two years of college.

7. In three fourths of the cases both partners to the union were employed with average individual yearly earnings of $4200.

8. Seven of the seventeen participating males were from the South.

9. Of the thirty-four participating individuals twenty-nine had church affiliations.

10. In political and social philosophy the views expressed were of the type usually characterized as "liberal"* with strong defenses built up in relation to "traditionalism."

11. In skin pigmentation and physiognomy the Negro spouses exhibited a range typical of the American Negro.

12. Original social contacts occurred through common employment or common educational pursuits.

13. Family objections were incurred in virtually all of the unions, the most severe objections being registered by the parents of the white spouse.

14. Social life subsequent to the union was confined largely to the Negro community. Friendships prior to the union were usually discontinued and replaced by new contacts, mostly in the Negro community.

15. Of the white female partners, most of them revealed attitudes of resentment in relation to their mothers.

Conclusions

1. The security feelings of the individuals both as regards to employment and status within the community tended to be negatively affected by the unions.

2. The attitudes of the participating individuals tended to reflect a measure of resentment, negativism and rebellion.

3. There still persisted in the attitudes of most of the participants a fair degree of racial prejudice.

4. Satisfactory and progressive interpersonal adjustment seemed evident in nearly all the unions under investigation.

5. The present study tended to confirm earlier findings regarding mixed marriages in the fact that the colored or more highly pigmented partner is usually the male. In this connection attention has usually been called to the relative advantage of the male in the establishment of marital relations.

6. The happiness of the white spouse appears to depend upon (1) the kind and level of expectations held prior to marriage; (2) the amount of realistic preparation for life in a Negro community that took place prior to marriage; and (3) the ability of the spouse to adjust to many social and economic limitations experienced by Negro Americans. 112 pages. $1.40. Mic 56-1590

*That is, "liberal" as opposed to the more conservative and conformist attitudes in the sphere of social relations.

SOME EMPIRICAL RELATIONSHIPS OF A PRESCHOOL SOCIOMETRIC TECHNIQUE

(Publication No. 16,123)

Helen Rowena Marshall, Ph.D.
State University of Iowa, 1956

Chairman: Professor Boyd R. McCandless

The investigation proposed 1) to devise a functional and stable sociometric choice technique for preschool children; 2) to investigate its stability over time; and 3) to explore two types of relationships. The first of these relationships was between sociometric choice and the teacher's judgment of "closest friends." The second relationship was between the sociometric choice of the child and his interaction with and choice of companions in free play.

In three newly formed preschool groups, children's sociometric choices were measured by a photograph sociometric interview at three or four test intervals of ten calendar days. Teachers' judgments of "closest friends" were obtained at corresponding times for the 19 children in each group. A reliable observation method was developed to provide quantitative measurement of four categories of social behavior. Three series of 100 minutes of observation of each child's spontaneous play interactions were recorded in two groups. The data obtained by these methods met the assumptions required for product moment correlation.

For child and teacher populations like those of this investigation, the findings support the following conclusions:

1. Stability of sociometric scores will not be found consistently between three or four test intervals of ten calendar days, although fairly high stability (r's of .73 to .85) may occur over such test intervals for any group.

2. Stability of teachers' judgments of social acceptance will be found between three or four test intervals of ten calendar days.

3. As length of acquaintance increases, (a) children engage in more social interaction; (b) the relative degree of various kinds of social participation becomes stable for children in the group; and (c) stability of relative social acceptance in spontaneous play neither increases nor decreases beyond the range of r's of .50 to .69.

4. Sociometric acceptance is related to the quality of the social behavior of the child in spontaneous play. The frequency of verbal choices of the child by other children varies systematically with the degree to which the child participates in the qualitative categories of associative play, friendly approach, and conversation. Sociometric acceptance is not related to the number of hostile interactions of the child.

5. Extent of acquaintance influences the relationship existing between sociometric scores and social interaction scores for the friendly categories. Changes in the observed number of social interactions in each category occur at the same time as changes in the child's sociometric score.

6. The relationship between sociometric acceptance and pooled teachers' judgments of this acceptance is positive in direction but the significance of this relation varies from group to group and test period to test period.

7. Pooled teachers' judgments of social acceptance are positively related to the observed quality of the child's

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behavior, or to the number of social interactions with other children in friendly, but not hostile, behavior categories. Extent of acquaintance does not influence the existence of this relationship.

8. The overall best friend score (social acceptance in spontaneous play) and friendly category best friend scores are related to (a) sociometric scores in a positive direction, significant in half the test periods; and (b) pooled teachers' judgment scores in a significantly positive direction. Neither relationship is affected by extent of acquaintance.

9. Agreement between the photograph sociometric interview, play interactions in a natural setting, and individual teachers' judgments in the choice of the child's three best friends is greater than that of chance. There are marked differences in individual teachers' ability to predict the child's sociometric acceptance.

181 pages. $2.26. Mic 56-1591

RACE PREJUDICE AMONG CATHOLIC COLLEGE STUDENTS IN THE UNITED STATES AND ITALY: A COMPARATIVE STUDY OF THE ROLE OF RELIGION AND PERSONALITY IN INTER-GROUP RELATIONS

(Publication No. 15,676)

Charles Terrance O'Reilly, Ph.D.
University of Notre Dame, 1954

This study of anti-Jewish and anti-Negro attitudes tested several hypotheses about the relationship between prejudice and personality and prejudice and religion. Questionnaires were distributed to 120 Catholic Italian men and women university students, and to 559 Catholic men and women attending Catholic colleges in the middle western, north eastern and south central United States. Stress was placed upon the comparability of data obtained in the United States and Italy, and that obtained by the present study and by prior studies of prejudice. The study thus presents material from the point of view of replication and also serves as a source of cross cultural data.

Anti-Jewish prejudice was tested with the Levinson and Sanford antisemitism scale which was used unchanged in the United States, and in an abridged form in Italy. It was found to be highly reliable in both countries, as was a specially constructed anti-Negro scale used in both countries. A religion scale used in the United States also proved highly reliable. The scales were supplemented by items dealing with the subjects' social backgrounds and their religious practice, and by items designed to elicit information about the relationship between prejudice and personality and prejudice and religion.

The Americans in the present study scored almost uniformly lower in anti-Negro attitudes than did the Italians. They also scored significantly lower in antisemitism, and almost uniformly lower than did those Americans reported upon by prior studies which had also used the Levinson and Sanford scale. Although the Italians strongly held certain common stereotypes about Jews and Negroes, they scored low on items which implied overt action against a minority. Anti-Jewish attitudes were significantly associated with anti-Negro attitudes in the United States, and were appreciably, although not significantly associated with anti-Negro attitudes in Italy.

The Authoritarian Personality hypothesized that those who emphasized obedience and respect for authority tended to be more prejudiced. When tested, however, no significant tendency toward greater prejudice was found in our subjects. Neither was there a tendency toward greater prejudice on the part of those who felt victimized as members of a minority, as had been hypothesized by Allport and Kramer, nor among those who claimed that their attitudes toward minorities "mirrored" those of their parents. Belief in the Supernatural, and belief that some things can never be explained by the human mind, were not coupled with prejudice in this study, contrary to the findings of The Authoritarian Personality. And although a majority of the subjects reported that religion played an important role in their lives, there was no significant tendency for them to be more prejudiced, which did not agree with an hypothesis of Allport and Kramer. There was, however, a significant tendency for anti-Jewish attitudes and anti-Negro attitudes to be associated with lesser acceptance of the teachings of the Catholic Church.

Attendance at Mass and the reception of Holy Communion, religious "core practices" for the Catholic, were positively and significantly related to religion scores. As the incidence of religious practice declined, the attitude toward religion became less favorable, revealing a functional relationship between the religious beliefs and the religious practice of our Catholic subjects. The fact that the more religious subjects invariably tended to reject manifestations of prejudice seems to indicate an integration of their part of the theological and social aspects of religion.

More frequently than not our testing of hypotheses produced results which differed from those of prior studies. This may have been due to the ambiguity with which the word religion is used in much current research, where religious preference and church membership are used to measure "religion" although they are woefully inadequate. Religion and prejudice have often been linked because unrepresentative samples have been used and because of the lack of a clear definition of religion for operational purposes. Furthermore, the psychoanalytic orientation of some researchers has caused undue stress upon factors like obedience, respect for authority and belief in the supernatural as indices of "authoritarian" tendencies in religion. Some of the differences between this and prior studies may be due to the fact that our subjects were Catholic, with a different value system than non-Catholics. Testing hypotheses showed that a number of those used in social psychology, presumably based upon sound theory and research methodology, could not stand the test of replication. Among other things, this finding emphasizes the complexity of the relationship between attitudes and personality and the danger of projecting findings from individual psychology into the field of social psychology.

The similarities revealed between Italian and American attitudes may point toward an essential sameness in attitudes that merits further investigation. The role of religion in relation to prejudice should be carefully studied. Numerous studies assert that members of particular religions, or the "more religious" tend to be more prejudiced. The varied responses of our subjects, both in regard to anti-minority attitudes and in regard to religious beliefs, reveals the need to qualify many assumptions made by social scientists about the nature and influence of religion.

236 pages. $2.95. Mic 56-1592

SOCIOLOGY, GENERAL

A PROPOSAL FOR COMMUNITY EDUCATION IN SELECTED RESETTLEMENTS IN PUERTO RICO

(Publication No. 12,206)

Cecilia G. Dávila, Ed.D.
New York University, 1955

This report presents the patterns of living, needs, and problems of educational adjustment in selected resettled communities in Puerto Rico. An integrated program for the improvement, based on the results of the study, is proposed.

For the attainment of this objective, a survey of nine selected rural communities was carried out. The study was based on a sample of communities and of families within the communities. A three-stage probability sample scheme was used.

Data, which were mostly collected from field sources, were gathered through interview schedules, questionnaires, check lists, and direct observation and participation in community activities.

In 1950 about 60 per cent of the population was rural in Puerto Rico. This is open-country neighborhood rather than village living. A great majority of the country people are farm workers dependent upon their wages for their livelihood. Most laborers live as landless squatters or "agregados" whose living conditions are completely inadequate.

To cope with this situation the government of Puerto Rico started a new system of land policy, with the approval of the Land Law of Puerto Rico in July 1941, which created, among other things, a new pattern of land ownership and rural settlement in the Island. The resettlement of "agregados" in communities is one of several important steps taken by the government to improve living conditions of rural laborers. Because of the uniqueness of this program and its implications for the future of the rural population of Puerto Rico, a scientific examination of objectives and attainments was due. Thus, the investigator undertook a study of the Puerto Rican experiences in rural resettlement.

The results of the investigation indicate that the creation of rural communities or planned villages in Puerto Rico represents a social gain when compared with the open-country type of settlement. The advantages are apparent: close and intimate contact with neighbors, proximity to social institutions, facility of mutual aid and cooperative activities. The community dweller is achieving more satisfaction and lives a life that is more complete than the isolated dweller.

Yet, many community services continue to be unsatisfactory. The economic institutions, in spite of their efforts, have not created permanent sources of employment to provide higher income and higher levels of living.

In general, the facilities that need to be provided within the rural communities can be divided into three major groups: health, economic and social requirements. Under the heading of health requirements the major ones are: the supply of pure water, provision of adequate medical care and services, better housing, and development of sound hygienic habits. Under economic requirements can be listed the following: new sources of employment, higher income, proper agricultural techniques, better means of transportation and communication, the creation of new industries, and all sorts of cooperative enterprises. The third group includes: more adequate school facilities, means of recreation, community centers, libraries, clubs and organizations, religious associations, and opportunities for social participation and cooperation.

The general conclusion is that in order to create a better environment for an overall socio-economic improvement program, emphasis should be given to community organization and community leadership. A program for community education is suggested which emphasizes the integration and coordination of the participants. The plan tends to orientate the rural people to set their goals and whenever possible, to meet their problems rather than to depend always on the government. To carry out the educational program modern methods and techniques such as the use of radio, newspapers, pamphlets, books, posters and charts, films, television, group discussion, selfhelp and cooperative activities are suggested.

240 pages. $3.00. Mic 56-1593

ADMINISTRATIVE CONTROL OF DEVIANT CONDUCT OF PHYSICIANS IN NEW YORK AND MASSACHUSETTS

(Publication No. 16,323)

Edwin Douglas Driver, Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. Thorsten Sellin

This study describes the formal, social controls employed by two agencies, the licensing authority and the unspecialized medical society, to regulate the deviant conduct of physicians. The specific objectives were to determine the: organization and procedures of the control agencies; formal norms and organized, negative sanctions administered by the agencies; incidence of reported and unreported offenses; and characteristics of the offenders among the approximately 30,000 New York and 8,500 Massachusetts physicians. The study covers the period, 1925-1952. Data were obtained from published and unpublished medical and legal reports, and through interviews.

The licensing authority, which is composed primarily of experienced physicians, is empowered to: investigate complaints, conduct hearings, issue subpoenas, administer oaths, and invoke discipline. It may reprimand the physician, or suspend, revoke or annul his medical license or registration when he is guilty of any of the following acts:

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criminal abortion, fraud and deceit, fee-splitting, aiding and abetting the unlicensed practitioner of medicine, addiction to or the illegal diversion of narcotics, habitual drunkenness, advertising for clientele, using a secret remedy to cure disease, unprofessional conduct, malpractice, and conviction in court of a crime or felony.

Medical societies control approximately 70 per cent of the physicians. They are permitted by the laws of incorporation to conduct quasi-judicial proceedings when a member is accused of violating the medical or the legal code. The guilty physician may be: reprimanded; forced to resign from the society; or suspended, expelled or dropped from membership.

Few offenses were reported to the agencies. The median numbers filed with the New York authority and the Massachusetts authority from 1925 to 1952 were seventy-two and fifty-four, respectively. Unprofessional conduct, fraud and deceit, malpractice, and advertising were most frequently reported. Discipline, usually in the form of suspension or revocation, occurred in 20 per cent of the New York and 24 per cent of the Massachusetts cases. Court conviction, fraud and deceit, and abortion were the main offenses disciplined. The number and types of complaints filed with the medical societies are similar to those which were filed with the licensing authorities. The societies, however, disciplined less frequently and less severely.

Reported offenses constituted a small fraction of the total deviant acts committed by physicians. Several factors are presented to explain the low reportability and detectability of these acts. Both reported and unreported offenses tend to substantiate the hypothesis of Aschaffenburg, Lawes, and Sutherland that the forms of illegal conduct are closely associated with occupational skills.

Offenders were more often than non-offenders: aged; male; urban residents; graduates of foreign or unapproved, medical schools; and non-specialists. Approximately 8 per cent of the offenders recidivated.

308 pages. $3.85. Mic 56-1594

A COMPARISON OF DISTRIBUTIONS BY CLASSES OF MIGRANTS WITHIN THE STATE OF WASHINGTON, 1949-50

(Publication No. 16,544)

David William Yaukey, Ph.D.
University of Washington, 1956

The subject of this thesis is the way different kinds of internal migrants distribute themselves. Specifically, the study is concerned with determining (1) what classes of migrants differed most in their distributions among available locations, (2) what characteristics of the locations best explain the differences between distributions and (3) what classes of migrants were attracted by these characteristics.

The population consisted of the 35,518 migrants into the state economic areas of Washington between 1949 and 1950 reported by the United States Bureau of the Census. Two bodies of information were available about these migrants, their personal characteristics and their destinations: The census tables classified the migrants on the basis of sex, color, type of residence in 1949, age, education, marital status, employment status, occupation, and income. The tables also recorded how many migrants in each of these classes went to urban, rural-nonfarm, and rural-farm residences, and how many went to each of the eleven state economic areas.

The analysis consisted of comparing the distributions of classes of migrants. The first phase of the analysis determined the major differences between classes of migrants in their distributions among the three types of residence. The second phase of the analysis correlated differences between distributions among state economic areas with characteristics of the areas; the purpose of this phase was to determine what characteristics best explained the differences between the distributions and what classes of migrants favored these characteristics. The measures used were percentage distributions, total differences between percentage distributions, and indexes measuring the difference between classes' responses to each location.

One basic distinction among migrants appeared to be based on position in the life cycle, as defined by age and marital status. Among the young, unmarried migrants, sex was an important determinant of destination choice. Since middle-aged, married migrants behaved as families, sex was no longer a determinant, but socio-economic status was important. Old migrants distributed themselves in a way different from either young or middle-aged migrants. In addition, color and previous type of residence had much effect on choice of destination.

Each of these types of migrants favored locations with particular sets of characteristics. Young females, or older ones still in the labor force, chose urban residences with a variety of commercial facilities and a resident population containing many people like themselves. Young males were moved primarily through military assignment, but the civilians tended to select rural-nonfarm locations more than did the comparable females. Families with higher socio-economic status, as measured by education and income, were more likely to choose urban residences, especially those with high levels of living and high degrees of opportunity for occupational mobility. Old people relatively favored urban locations, but selected those locations with other old people and with little economic change or growth. Nonwhites strongly favored urban locations, especially the most metropolitan cities. Migrants who had lived on farms were more likely to choose rural destinations than were migrants who had lived in nonfarm areas.

These specific results are interpreted in a series of hypotheses about differential inmigration in the United States as a whole. In addition, a revised method is proposed for studying differential inmigration into other states, using census data.

189 pages. $2.36. Mic 56-1595

SOCIOLOGY, PUBLIC WELFARE

SOCIAL CRISIS AS A CHARACTERISTIC OF TUBERCULOSIS ETIOLOGY

(Publication No. 16,534)

Norman Gilbert Hawkins, Ph.D.
University of Washington, 1956

The central problem of this thesis is the relation of personal and social interaction to human disease. The theory proposed is that disease is an adaptation to crisis in one's cultural experience. Hypotheses connecting this theory to the onset of tuberculosis were formulated and tested in two groups of sanatorium workers matched individually on eleven variables. It was predicted that twenty employees who had contracted tuberculosis would show a history of social crisis in the two years preceding illness, evidence of personality disorganization, and correlation between measures of crisis and disorganization.

Crisis was defined as a decisive magnitude of taxis (trial-and-error adjustment to unwanted features of the environment), measured by the Schedule of Recent Experience, a record of specific events for ten years prior. The Cornell Medical Index, a standardized inventory for estimating lack of organic integration, was used to measure personality disorganization. Test-retest reliability coefficients were .831 for the SRE and .805 for the CMI.

Four predicted aspects of crisis – location, elevation, consistency, and mean taxis level – were tested for significant difference between the groups. Six dimensions of disorganization were tested in like manner. Rectilinear correlation between crisis and disorganization was computed.

Three aspects of crisis were significantly present among ill employees, but mean taxis level was lower for them. Five dimensions of disorganization showed significantly higher levels for the ill employees. Correlation between crisis and disorganization was negative instead of positive as predicted. The theory relating social stress to the appearance of disease was tenable by eight of the eleven predictive measures. These eight included all measures relating to the pattern of responses.

The records of forty patients used in testing reliability indicated that true differences were underestimated by the matched comparison. Separate categories of the Schedule of Recent Experience showed consistent concentration in the two years prior to onset in the ill group, so that the unitary scoring appeared justified.

There were two byproducts of testing. It was found that the tuberculous are significantly variable in response, both as a group and individually. Sanatorium patients showed evidence of an adaptive phase following crisis and corresponding with onset of the disease.

Three stages of disruption, adaptation, and reorganization were suggested by the findings. Interesting parallels were found in the literature on schizophrenia.

The study presents evidence of limited scope. Validity of the theory is further restricted by the ex post facto design. The instruments used have not been widely applied and their use here was relatively crude. However, the quantification of life experience as a reliable differentiation of criterion groups is adequately demonstrated.

189 pages. $2.36. Mic 56-1596

A COMPARATIVE STUDY OF VOCATIONAL REHABILITATION LEGISLATION FOR THE SEVERELY HANDICAPPED ORTHOPEDIC CIVILIAN IN GREAT BRITAIN AND THE UNITED STATES

(Publication No. 12,243)

William Miller Usdane, Ph.D.
New York University, 1955

Chairman: Professor Roland H. Spaulding

The problem of the study was to present, analyze, compare and evaluate the legislation pertaining to the vocational rehabilitation of the severely handicapped orthopedic civilian over sixteen in Great Britain and the United States from World War II through 1953. Four sub-problems were considered: (1) What is the current legislation under the existing rehabilitation programs in both countries? What implementation and interpretation has been achieved in both countries with the existing legislation? (2) What is the proposed and pending legislation? (3) What are the similarities and differences between the two countries' legislation? (4) What are the needs appropriate for their requirements? What additional vocational rehabilitation legislation to current legislation is necessary in order that these needs can be covered adequately?

It was hypothesized that there were consistent legislation differences between both countries, that there were severe gaps in services in the existing legislation and that there was considerable difference between the number needing vocational rehabilitation and the legislation and implementation of such legislation which provided assistance for them.

The study did not propose to establish justification, however, for either the Federal-State program in the United States or the program of nationalization in Great Britain.

To evaluate consistent differences between the two countries, criteria for appraisal were obtained from a philosophical mooring as represented by an integrated consensus of representative thinkers in the field of rehabilitation. A definition of vocational rehabilitation was established and the selection of representative figures was made in conformity with the definition. A critical examination was then made of the principles and ideas of Dr. Howard A. Rusk, Dr. Henry H. Kessler, Dame Georgiana Buller, Dr. Harold Balme and Colonel John N. Smith, Jr. through their publications and speeches. Distinguishing characteristics were then synthesized into the determination of ten groupings of characteristics constituting the accepted philosophical mooring from which the criteria were derived, identified and applied to the legislation.

A Questionnaire also was devised specifically related to five of the derived criteria. The Questionnaire was utilized, however, only to fill in gaps of information rather than to supply the complete range of information required.

The criteria, applied to the legislation of both countries, revealed consistent differences between them. Through the Questionnaire, it was also found that there were severe gaps in services and that there was a considerable difference between the number needing vocational rehabilitation in both countries and the legislation and implementation of such legislation which provided assistance for them.

Among the major recommendations for the development of effective legislation providing comprehensive vocational rehabilitation services for the severely handicapped orthopedic civilian were the following:

1. Continuous, coordinated rehabilitation administration affording the maximum achievement possible.
2. Establishment of rehabilitation centers in close proximity to sheltered workshops including pre-vocational and vocational evaluation as well as vocational training.
3. Training of a limited number of non-handicapped along with the severely handicapped.
4. Mobile rehabilitation teams to be situated strategically on an interim basis until adequate facilities are built and staffed.
5. Longer period of time for the vocational rehabilitation of the congenitally severely handicapped orthopedic.
6. Continuous interpretation to the community on a national and local basis of problems, programs and objectives of their vocational rehabilitation.
7. Assistance in the purchase of transportation equipment.
8. Research provisions in the legislation should include,
   a. Adaptation of industrial machinery for use in industry as well as for the homebound.
   b. Follow up studies on a continuous basis to evaluate services needed.
   c. Counseling and training techniques for the severely handicapped.
9. Utilization of existing comprehensive centers in the United States and residential colleges in Great Britain for the training of professional personnel in teamwork approach.

717 pages. $8.97. Mic 56-1597

SOCIOLOGY, RACE QUESTION

BIRACIAL EDUCATION IN THE SOUTH: A STUDY IN SOCIAL CHANGE

(Publication No. 16,168)

John Ansley Griffin, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor William H. Sewell

The purpose of this study was to describe, analyze, and interpret sociologically changing patterns of biracial education in the South and to relate such changes to changes in the economy and in the population. Trend lines of indexes of changes in the three areas were to be studied to determine the dependence of biracial educational change on the other factors. Trends were to be projected in order to estimate the time required for the achievement of certain educational goals. From the whole study were to be drawn whatever conclusions concerning race relations and social change as might emerge.

The historical data dealing with biracial education since the Civil War, developments in the economy, and the population patterns were studied to provide the social-cultural context. Trends in school-expenditure data by race for six states over a period from 1931-32 to 1951-52 were established and analyzed, particularly with reference to economic trends as seen in income statistics and population trends as seen in urbanization data. To further test the dependence of biracial data on economic and population changes, sample county data were studied to see if biracial expenditures varied consistently in relation to variations in levels of county income and degrees of urbanization.

It was found that expenditures for Negro education were significantly correlated with both income levels and degrees of urbanization. The analysis of the county data supported the findings of the trend analysis. Thus the expenditures on a school child are a function of race, the level of income of county or state, and the place of residence — rural, rural-urban, or metropolitan. For the Negro the fact of race has been the most significant influence, and the place of residence has been more significant for Negroes than for whites.

The projection of trends indicated that Negro and white expenditures should be equalized by 1958-59, if biracial education were continued. It was further found that Southern expenditures for schools should achieve national norms by 1965, if the current ratios of educational spending to income were continued.

From the study it was concluded that biracial education changes coming in the last two decades have been significantly influenced by changes in the economy and in the population. Changes in the three areas, although occurring in regional diversity, have moved the South toward the social-cultural norms of the nation and may be expected to continue.

274 pages. $3.43. Mic 56-1598

ROBERT EDMOND JONES: POETIC ARTIST OF THE NEW STAGECRAFT

(Publication No. 14,683)

Eugene Robert Black, Ph.D.
The University of Wisconsin, 1955

Supervisor: Professor Ronald E. Mitchell

The work of Robert Edmond Jones as a scene designer, a director, and a producer has had more influence on the modern American theatre than that of any other scenic artist. Although the importance of his work has been widely recognized, there never has been a systematic analysis of his contributions to the American theatre. The purpose of this dissertation is to trace the pattern of Jones' career, and to relate his philosophy of theatre to the concrete character of his stagecraft.

The study has been organized into three sections which define the progression of Jones' career: "The Early Period," "The Dynamic Period," and "The Search." In the first section, Jones' early apprenticeship and first professional commissions are analyzed. The second section traces his development into a leading scene designer through his associations with Arthur Hopkins and The Experimental Theatre, Incorporated. In the third section, his later production ventures are examined and Jones' principal writings on the modern American theatre are reviewed.

Directly and indirectly, the designs and essays of Robert Edmond Jones stirred the imagination of artists and laymen of the theatre for forty years. As a worker in the theatre he introduced the principles of the "new stagecraft" to the American professional stage. His enthusiasm was instrumental in the founding of the Washington Square Players (The Theatre Guild) and the Provincetown Players. He was the first American designer to experiment with unit settings and to use light and color as integral parts of unified stage design. During his career, he also pioneered in areas other than the legitimate stage, being the first art director for the fabulous productions mounted at the Radio City Music Hall, and designer of the decor and costumes for the first three-color process Technicolor films. As a producer, Jones participated in the reorganization of the Provincetown Playhouse and started the Central City Opera House towards its present eminent position as a summer art festival center.

The genius of Jones, however, was his ability to articulate through his work and his literary efforts the philosophy of the New Movement. These ideas were known to many in America, but it remained for Jones to demonstrate their efficacy. The spirit which motivated Jones' work sets him apart from his contemporaries in the theatre. He accepted the premise that perfection should be the goal of the theatre artist, and exhorted the young people of the theatre to strive consciously for sublime theatrical expression. His conviction that beautiful theatre is actually possible now – anytime – permeates his writing, was implicit in his scenery, and magnetized his personality.

While our important American playwrights have been extensively treated in books and theses, our scenic artists, who have been equally articulate in shaping our contemporary production styles and philosophies, have been almost totally ignored. It is hoped that by analyzing the work of America's dean of scene designers, students of the theatre who are unacquainted with the evolution and contributions of the "new stagecraft" will appreciate anew their theatre and will continue the search for what Jones called "images of magnificence."

361 pages. $4.51. Mic 56-1599

THE CONSTRUCTION AND TESTING OF A FORCED-CHOICE SCALE FOR MEASURING SPEAKING ACHIEVEMENT

(Publication No. 15,816)

Keith Brooks, Ph.D.
The Ohio State University, 1955

The study is concerned with the construction and testing of a Forced-Choice Scale for measuring achievement in public speaking. To attain this end, sixty college speech students were asked to write descriptions of the observable speaking habits of effective and ineffective speakers in their speech classes. Primarily from these descriptions, but also from Speech texts and available Speech Performance Check Lists, 261 descriptive phrases of speaking habits (desirable and undesirable) were collected and categorized. After checking these items for ambiguity and repetition, 133 items remained, and these were administered to 300 Speech 401 students. Each item was checked by these students on a 1-to-5-point scale indicating the degree of applicability to some one classmate the rater had in mind. After statistical preparation of preference and discrimination indices, 26 pairs of items remained for inclusion on the final test form.

The resulting Forced-Choice Scale was then compared with a simple Numerical Scale in terms of usability and efficiency. This was accomplished by having five different speakers rated daily for four days by two groups of students — a like number using each kind of scale and statistically analyzing the resulting data.

Among the major conclusions of this research are the following:

(1) The final Forced-Choice Scale consisted of 26 pairs of items – half on effective, and the other half on ineffective, speaking habits. Thirteen series resulted, each including two pairs of phrases describing both effective and ineffective speaking.

(2) A training period of at least one class meeting was needed to provide minimum adequacy in the use of the Forced-Choice Scale, in terms of student scale evaluation of the performance of others.

(3) For the student speakers used, the ranks determined by the Forced-Choice Scale and by the Simple

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

Numerical Scale were comparable. The rank order of the 20 speakers (5 speaking each day) was identical in both scales for 18 of the 20 speakers.

(4) The Forced-Choice Scale required no more time for student checking than did the Numerical Scale.

(5) The Scale developed in this study has particular value as a research instrument where values of criteria need not be explained to students who are rated.

(6) This Scale is an excellent predictor of rank order of all speakers when group scores are averaged.

121 pages. $1.51. Mic 56-1600

THE STYLE OF FIVE RADIO COMMENTATORS

(Publication No. 16,159)

Frederick Ritter Dowling, Ph.D.
The University of Wisconsin, 1955

Supervisor: Professor Henry Lee Ewbank

This study set out to investigate the style of radio news commentary by analyzing four elements of style: Word Choice, Sentence Characteristics, Rhetorical Devices, and Delivery. The materials for this study were five recorded broadcasts and the scripts of Edward R. Murrow, Elmer Davis, Fulton Lewis Jr., Lowell Thomas, and Gabriel Heatter.

Two aspects of style – Word Choice and Sentence Characteristics – were examined objectively. Rhetorical Devices and Delivery were examined subjectively.

The Word Choice study was divided into two parts: Word Difficulty, and Vividness and Appropriateness. Word Difficulty was determined by (1) Syllable Count (44,022 words), and (2) the E. L. Thorndike General Word Count and the Irving Lorge Magazine Count. The syllable count data was subjected to a Chi square analysis to determine the significance of each man's choice of words.

Sentence Characteristics were divided into three sections: Sentence Length, Sentence Kind, and Sentence Use. Sentence Length data was subjected to a Chi square analysis to determine the significance of the differences in each commentator's data and also among the five commentators. Sentence Kind included sentences of different grammatical complexities while Sentence Use concerned Declarative, Interrogative, Exclamatory, and Imperative sentences.

Ten Rhetorical Devices were used often and prominently enough to warrant study: Transitions, Questions, Topic Sentences, Humor, Epigrammatical Statements, Emotional Proof, Ethical Proof, Logical Proof and Repetition. Each commentator favored a few of these devices, some by frequency of use and some by excellence of use.

Delivery was examined under six headings: pitch, force, rate, enunciation and pronunciation, quality, and reading ability. Principal attention was given to the elements of delivery favored by each commentator.

Ten specific conclusions were reached: (1) Each commentator is relatively consistent in his use of: words on various levels of difficulty, sentences of various lengths and complexities, various rhetorical devices, and factors of delivery. Scripts can be identified on the basis of these criteria. (2) Each commentator is relatively inconsistent in his day-to-day use of words on different difficulty levels. (3) Each commentator differs significantly in his use of words on various levels of difficulty. (4) Each commentator differs significantly in his use of sentences of various lengths. (5) Each commentator is consistent in his use of sentences of various lengths. (6) Each commentator is consistent in his use of various kinds of sentences classified according to grammatical construction. (7) Each commentator differs measurably in his use of sentences classified on the basis of complexity. (8) Commentators make little use of Interrogative, Exclamatory and Imperative Sentences. (9) Each commentator's style can be partially identified by the presence or absence of four or five rhetorical devices which tend to vary with the commentator. (10) Commentators make very little use of the following devices: Quotations, Questions, Humor, Epigrammatical Statements, Ethical Proof, Emotional Proof and Logical Proof.

Four general conclusions were reached: (1) Radio Commentary closely parallels what has been defined as Oral Style. (2) Commentators can be differentiated on the basis of style differences. (3) A study of: Word Vividness and Appropriateness, Sentence Characteristics, Rhetorical Devices, and Delivery clearly define an individual's style. (4) A study of Word Difficulty does not clearly differentiate one commentator from another.

210 pages. $2.63. Mic 56-1601

A STUDY OF THE ATTITUDES OF INDUSTRIAL MANAGEMENT PERSONNEL TOWARD COMMUNICATION

(Publication No. 15,831)

Dwight Lowell Freshley, Ph.D.
The Ohio State University, 1955

The study had as its objectives the indirect measurement of the attitudes of industrial management personnel toward their industrial communication and the discovery of the relation of attitude test scores to five variables inherent in the industrial communication situation. The variables were: size of company, years of management experience, level of management, age, and number of people under direction. Finally, the study sought to produce training material on communication for management training programs.

The first step in the procedure was to examine all the available, pertinent literature for statements which could be interpreted as hypothetical principles of industrial communication. A list of over four hundred statements was produced.

From two hundred of the best hypothetical principles seventy-five items were constructed for the pre-test form. The items described very brief incidents which attempted to simulate a typical industrial communication situation. The incident was followed by five alternative solutions involving different communication approaches.

The pre-test sample was an expert group of twenty-four persons who ranked the alternatives for each item 1 to 5. The median rank for each alternative, together with the author's a priori ranking, became the expert key. A Q value or ambiguity score for each alternative and item was computed to eliminate poor items. Fifty items

were retained for use in final forms. Two parallel forms of thirty items each were used in the final tests. The first ten items were the same for each form.

The tests were distributed personally to seventeen industries in nine cities located in two states. The industries ranged in size from 500 to 20,000.

Data was coded from one hundred responses to each form. The statistical procedures used, and the results obtained, follow.

The Pearson product moment correlation was used in computing the split-half reliability technique for both forms. The correlation coefficient was +.72 for Form D and +.658 for Form F. These were corrected for length by the Spearman-Brown formula. The standard error of measurement for Form D was .048; for Form F it was .060.

After examination of difficulty indices and item test correlations, certain items were re-keyed. On Form D the revised key split-half reliability was +.632. Form F produced a +.916 reliability coefficient of correlation.

Difficulty indices and item-test correlations were derived for each item. The mean difficulty scores for Form D and Form F were 62.1 and 60.5 respectively. The mean difference was 1.6, not significant. The average item-test correlation for Form D was +.435; for Form F, +.50.

A t-test was computed to determine the significance of difference between the means of correct answers for the duplicated ten items of each form. The results, which were not significant, suggest that the two groups, of one hundred subjects each, came from essentially the same population.

Chi squares were computed for discovering differences in attitude test scores and the five variables. Significant differences were found for size of company and level of management, while no significant differences were found for age, years of management experience, or number of people supervised. 167 pages. $2.09. Mic 56-1602

COMMUNICATION ATTITUDES OF INDUSTRIAL FOREMEN AS RELATED TO THEIR RATED PRODUCTIVITY

(Publication No. 16,464)

Frank E. Funk, Ph.D.
Purdue University, 1956

Major Professors: A. H. Monroe and C. H. Lawshe

This investigation had two main purposes: first, to examine certain attitudinal dimensions concerning the communication activities of first line industrial foremen; and second, to test for any differences in these "communication attitudes" in higher and lower production-rated foremen.

Two different attitude questionnaires were constructed and administered to a sample of foremen rated by their superiors as higher or lower-rated foremen. The first survey served primarily to test and refine the attitude questionnaire and the experimental procedure, while the second survey was used to make the communication attitude comparisons of five higher and lower production-rated groups. In the second survey, both judging of items and item-analysis procedure were used in developing four scales from the questionnaire. These scales were designed to measure foremen's attitudes toward the people with whom they work as well as toward communication with these people. Specifically, the scales were designed to measure foremen's attitudes towards: 1) communicating and the subject matter of communications; 2) workers; 3) the "boss" or immediate superior; and 4) higher management.

Three superiors in each of five departments of the company rated their foremen on a researcher-constructed rating form which forced these raters to name a certain number of foremen for each of five categories, ranging from higher to lower productivity. This provided five production-rated categories for analysis.

After administration of coded questionnaires and scoring of papers according to a key developed by four judges, item analyses of each scale were used to select the final items and the correct response for each. Further statistical procedures included analyses of variance, and a discriminant function using the Wherry-Doolittle computational procedure. These and other procedures were used to test for: 1) a relationship between the communication attitudes as measured by the four scales and the criterion productivity-groups; 2) the degree of any such relationship; 3) any departmental differences; 4) communication attitudes differentiating higher from lower production foremen; and 5) the attitudes of the foremen sample as a whole.

The following conclusions were drawn for the variables as measured and for the population under study:

1. As compared with lower production foremen, higher production-rated foremen have more favorable attitudes toward communications aspects of their job, toward their workers and communicating with these workers.
2. No statistically significant differences were found between higher and lower production-rated foremen in their attitudes toward their immediate superior, and in their attitudes toward higher management.
3. When foremen were classified by departments, these department groups were not found to differ significantly in mean communication attitude scores on any of the four scales.
4. The degree of the relationship between communication attitudes and productivity was significantly different from one department to another.
5. Content analysis of items which discriminated most between higher and lower production-rated foremen suggested that higher rated foremen are more communication-minded, have more favorable attitudes toward workers, and are more confident and understanding.

The most important general conclusion to be drawn from this study is that certain communication attitudes of industrial foremen are related to their rated productivity.
149 pages. $1.86. Mic 56-1603

A STUDY OF INDIVIDUAL DIFFERENCES IN ABILITY AND ACHIEVEMENT OF COLLEGE STUDENTS IN THE ORGANIZATION OF IDEAS

(Publication No. 15,839)

Robert Stanton Goyer, Ph.D.
The Ohio State University, 1955

The research problem was to determine the degree and nature of individual differences among certain college students in selected aspects of the ability to organize ideas. The major purposes of the study were to develop, validate, and evaluate an instrument which measures aspects of this ability, and to suggest relationships between organizing ability so measured and such variables as (1) subjects' centile ranks on the Ohio State Psychological Examination (O.S.P.E.), (2) their part-scores on each of four categories of organizing skill, (3) their general knowledge in a given subject-matter area, (4) their year in college, and (5) their general public speaking ability.

The methodology used in constructing the present test initially involved developing and gathering together a pool of potential test items. From this pool of approximately 400 items, 135 were selected for inclusion in five pre-test forms after having been evaluated in terms of the appropriateness of the subject matter, the item form, the relationship of the item to the purposes of this test, and the desired level of difficulty.

The pre-test forms were administered to beginning college speech students, and the resulting data (N = 100 for each form) were analyzed statistically to determine the reliability of each test form and to suggest each form's validity in terms of a total test score criterion. Simultaneously, the items were submitted to a panel of five critics for their considered opinion as to whether or not they measured organizing skills.

From the 135 items, 102 were then selected on the basis of specific criteria for inclusion in two equivalent final test forms (Form 556A and 556B). These final forms were administered to beginning college speech students, from which data (N = 100 for each form) reliability correlations (split-half) for each form were computed (r = +.796 for Form 556A, and +.825 for Form 556B), as were item difficulty and discrimination indices. Among the major conclusions of this study are the following:

(1) Correlation coefficients between subjects' O.S.P.E. centile ranks and their organization test scores were +.666 for Form 556A, and +.726 for Form 556B, a finding which suggests that a high positive relationship exists between the ability to organize ideas and intelligence.

(2) When the difference between the mean scores of the two samples (matched according to O.S.P.E. centile ranks) who took the final test forms were computed (t test), the conclusion was reached that the samples were from the same population, since the difference was not significant.

(3) The part-remainder correlations for each of four categories of organizing skill suggest that Category II (Sequential Relationships) is the best single predictor for Form 556A, and Category I (Part-whole Relationships) for Form 556B. However, when Forms 556A and 556B are considered together, Categories III (Material-to-purpose Relationships) and IV (Relational Words and Phrases) seem the most consistent predictors of total achievement in organization.

(4) Knowledge in a given subject-matter area (facts and principles of public speaking) influences positively the ability of Speech 401 students to organize ideas in that area. This conclusion is based on a part-remainder correlation of +.720 between scores on fourteen test items in that subject-matter area, and the remaining items in Form 556A.

(5) A comparison between students' general speaking ability and their ability to organize ideas revealed (t test) that a difference of the means in favor of the above-average speakers existed at the 2 percent level of confidence, for both final forms of the test.

(6) A comparison between year in college and ability to organize ideas revealed (t test) that for both final forms a difference between the means exists at only marginal levels of significance. 113 pages. $1.41. Mic 56-1604

FUNDAMENTAL FREQUENCY CHARACTERISTICS OF THE SPEECH OF PROFOUNDLY DEAF INDIVIDUALS

(Publication No. 16,465)

David Samuel Green, Ph.D.
Purdue University, 1956

Major Professor: M. D. Steer

The purpose of this study was to investigate and describe the fundamental frequency characteristics of the speech of profoundly deaf persons. Specifically, it attempts to explore the relationship between factors of age, sex, and training, and measures of fundamental frequency.

Forty-nine profoundly deaf subjects, selected from the pupil enrollment at two schools for the deaf, were grouped by two age levels, sex and school. Having met the qualifications imposed by the experimental design of this study, they were recorded by means of a high fidelity tape recorder as they read a 40 word speech passage. These recordings were later converted to graphic representations of fundamental frequency by means of the Purdue Pitch Meter, an electronic period timer, a cathode ray oscillograph, and an oscillograph motion picture camera. An opaque projector was used to project the continuous photographs of fundamental frequency upon measuring scales. This enabled standard measures of fundamental frequency to be taken and quantified. For each subject the following fundamental frequency characteristics were compiled: mean, total range, functional range, variance, extent of inflections, extent of shifts, and percent of total shifts which were in an upward direction. A two by two by two three-way analysis of variance was made for each of the standard measures of fundamental frequency computed. These analyses yielded comparisons between schools, age levels, and sex, and their interactions. In order to determine if an individual's mean fundamental frequency would be repeated on a repeat reading of a given speech passage, additional recordings were made for several randomly selected subjects. Significance tests were performed on the two means thus obtained for each of these speakers.

Within the limits imposed by the experimental design, the equipment used, and the sample studied, the following conclusions appear justified:

1. No statistically significant differences among any

of the frequency characteristics studied were found which related to the two schools.

2. Relative to fundamental frequency, deaf boys and girls are distinguishable from each other on the basis of mean level, mean extent of upward inflections, and percent of upward shifts.

3. With respect to mean fundamental frequency, young deaf children are distinguishable from older ones.

4. A deaf individual's mean fundamental frequency on a repeat reading of a given speech passage shows definite signs of instability when the reading of the second passage immediately follows the first, and the chance that the mean fundamental frequency of the second reading will be different is heightened when the time interval between the two readings is increased.

In addition to the experimental findings above, the dissertation includes normative data concerning the fundamental frequency characteristics of the speech of the profoundly deaf. 106 pages. $1.33. Mic 56-1605

THE EFFECTS OF TIME AND FREQUENCY DISTORTION UPON WORD INTELLIGIBILITY

(Publication No. 16,407)

George Henry Kurtzrock, Ph.D.
University of Illinois, 1956

In an investigation of the effects of time, frequency and time-frequency distortion upon word intelligibility, representative versions of a recorded sample of 50 monosyllabic words were prepared and presented to a group of observers for identification. Six experimental conditions were involved: time compression and time expansion with frequency constant; frequency division and frequency multiplication with time constant; slow play and fast play with time and frequency varying reciprocally. The phonetic structure of the materials permitted study of both general and specific effects. Ten initial consonants, 10 vowels and 10 final consonants were employed five times each with all CV- and -VC transitions being unique. The major findings were as follows.

1. Intelligibility was unaffected over a wide range of time distortion. Fifty per cent intelligibility was obtained when the words had been reduced to approximately one-seventh of their original durations. Expansion of duration beyond 11 times the original had slight effect.

2. Intelligibility was considerably more sensitive to frequency distortion in the form of division or multiplication than to time distortion by comparable amounts.

3. When time and frequency were distorted reciprocally the intelligibility decrement was dominated by frequency distortion, although the effect of duration remained appreciable and significant.

4. Frequency multiplication had less effect upon intelligibility than frequency division by comparable amounts.

5. Individual words were ordered similarly in intelligibility as the amount of a given type of distortion was varied, but differently in the time distortion and frequency distortion conditions. There was a positive, but not perfect, relationship between the order of words in frequency division and multiplication.

6. Significant differences in intelligibility were obtained between words grouped according to specific initial consonants, vowels and final consonants in all conditions except time expansion, where the reduction in intelligibility was too slight to warrant analysis.

7. On the basis of the number of correct elements in error responses, vowels were found to be less intelligible than consonants in the conditions involving frequency distortion, but more intelligible than consonants in the time compression condition.

8. Differences between words grouped by various phonetic classes were generally small and were more often significant in the conditions of frequency distortion than in time compression. Certain trends were noted. Back vowels were more intelligible than front vowels in all conditions. Open vowels tended to be more intelligible than close vowels in time compression, but less intelligible in the other conditions. Voiceless consonants, whether initial or final, were more intelligible than voiced consonants in the frequency distortion conditions. Continuant consonants tended to be more intelligible than dynamic consonants in time compression. Lingual consonants were more intelligible than labial consonants in all conditions.

9. Combinations of classes and sub-classes of phonetic elements, such as are formed in words, were found to vary in degree of association with intelligibility, certain combinations being significantly associated.

86 pages. $1.08. Mic 56-1606

AN ANALYSIS OF THE COMIC ELEMENT IN THE CHESTER, YORK, COVENTRY AND TOWNELEY MYSTERY CYCLES

(Publication No. 15,958)

Donald James Savage, Ph.D.
University of Minnesota, 1955

Adviser: D. W. Thompson

The development of comedy in the mystery cycles can in part be attributed to the combined influences of four factors: (1) the Feast of Corpus Christi furnished a popular secular occasion for the production of these plays; (2) the method of production was conducive to the introduction of comic techniques; (3) the guilds who produced the plays were interested in producing them as secular entertainments; and (4) medieval society took a naturally permissive attitude toward the introduction of comic elements into the religious context of these plays.

Although the range of subject matter employed in the creation of comedy in the mysteries is not severely lim--ited, certain subjects seem to be more highly favored than others. Most of the comic instances to be found in the mystery cycles can be discussed under the nine headings: Pride, Anger, Excessive Practicality, Recalcitrancy, Cuckoldry, Vulgarity, Gluttony, Irreverence, and Sloth. In many instances comedy is based upon a mixture of these various materials.

Comic instances within the cycles represent a comparatively wide range of complication (levels of involvement). Certain instances are presented entirely upon the level of comedy of physical action; others are limited to the presentation of simple linguistic absurdities; on a

still higher level the cycles present well-developed instances of situational comedy; and in their most complex form the cycles present forms of comedy involving the development of ironic relationships.

In terms of narrative form the four cycles follow essentially the same organizational pattern. The strongest concentrations of comedy, however, are to be found in the Towneley and the Chester Cycles. The York and Coventry Cycles both contain significant comic passages, but no full scenes which exist for the purposes of comedy alone.

158 pages. $1.98. Mic 56-1607

REHEARSAL-DIRECTION PRACTICES AND ACTOR-DIRECTOR RELATIONSHIPS IN THE AMERICAN THEATRE FROM THE HALLAMS TO ACTORS' EQUITY

(Publication No. 16,424)

David George Schaal, Ph.D.
University of Illinois, 1956

Despite an ever increasing collection of data on the American theatre, the areas of rehearsal and direction and the relationships of the persons engaged in these activities have been the subject of relatively little investigation. It has been the purpose of this study to trace the origin and development of the basic rehearsal-direction practices and actor-director relationships of the American theatre. The approach has been both analytical and historical. The problem resolved itself into discovering answers to some specific questions: How many rehearsals were held? Where were they held? When were they held? How long were they? What directions were given? Who gave them? How were they given? How were they received? In addition an attempt has been made to discover the "why" behind the answers. In this connection it was necessary to relate rehearsal and direction changes to the changing pattern of theatre, drama, and life in America.

Because I have been particularly interested in the interaction of the people involved I have relied heavily on sources providing information by and about the actors and managers as they carried out their tasks: memoirs, diaries and journals, autobiographies, theatre rules and regulations, newspaper and magazine articles, and published interviews. In addition I have used theatre histories, annals, theses, criticism, and other evaluations for background and corroborative materials.

The arrival of the Hallam company marks the beginning of a professional theatre continuum in the United States. However, because the early American theatre was imported from England the first chapter of the present investigation is devoted to an analysis of the English rehearsal and direction practices which were brought to America by the Hallams. Subsequent chapters examine the manner in which these original practices were adjusted to, or altered by, the organization and operation of the early American stock company, the star system, the impact of realism and the autocratic director, the demise of the stock company, and the rise of the single play combination. The formation and successful operation of the Actors' Equity Association mark the point at which certain previously established practices were slightly modified and given the authority of law. The present study closes therefore with the establishment of this new status quo.

This investigation has revealed that basic changes have taken place in the rehearsal-direction practices and actor-director relationships of the American theatre. The actor's position has changed from one of membership in a relatively stable and continuous producing unit – the stock company, to one of occasional and fleeting membership in a relatively ephemeral producing unit – the single play combination; the actor has changed from stage business and character interpretations that were traditional and performed largely in front of the proscenium opening, to stage business and character interpretations that are original to each new play and performed almost entirely behind the proscenium opening; the actor's rehearsals have changed in number, length, and nature – from being few, brief, general and perfunctory, to being numerous, lengthy, detailed, and vital; and the actor has passed from a position of relative autonomy to one of relative subservience – to the director. Conversely, the acting manager who began his career in the American theatre by being only nominally in charge of rehearsal and direction and actually largely confined to the position of arbiter and administrator, restricted by the long established customs of traditional business, lines of acting, and possession of parts, has changed to a teacher of acting, a director in complete charge of the actor and the stage – an autocrat. In the terms of this investigation the American theatre has changed from an actor's to a director's theatre.

381 pages. $4.76. Mic 56-1608

A STUDY OF THE SPEAKING IN THE ANTI-SECRECY MOVEMENT, 1868-1882, WITH SPECIAL REFERENCE TO THE NATIONAL CHRISTIAN ASSOCIATION

(Publication No. 16,131)

Robert Wayne Smith, Ph.D.
State University of Iowa, 1956

Chairman: Professor A. Craig Baird

This is a study of the utilization of public address in the cause of anti-secrecy, by the National Christian Association from 1868 to 1882. Analysis is made of occasions and audiences, national, state, and local speakers, speech preparation, premises, style and delivery, and effects of the speaking.

The National Christian Association was founded in 1867 on the sole premise that secret societies constituted a threat to American church and state. The central office of this group was in Chicago. The organization drew its members from fundamentalist denominations which opposed secret lodges. The National Christian Association set into operation a national lecture system to bring its ideas to the attention of the public.

The National Christian Association lecture system was headed by a General Agent and Lecturer. His duties were to speak for the reform throughout the country, and to set up state auxiliary associations and lecture systems in the various states. The greatest responses to these efforts

were in the middle-west, and in the New England States. A total of twenty-eight state associations had been established by 1882.

The state lecture system was organized much as was the national program. State lecturers were appointed at state conventions. Their duties consisted of speaking throughout their respective states, and of organizing county and other local associations. Local lecturers, in turn, were selected by the state lecturers, and were encouraged to present speeches in the local communities. The most successful responses were met in rural communities among folk of modest means.

The speech materials used by the state and local speakers were garnered from the publications of the National Christian Association, from the exchange of ideas with other speakers during the annual national conventions, and from periodic visits by the General Agent and Lecturer.

The outstanding speakers of the National Christian Association were: 1) Jonathan Blanchard, President of Wheaton College, and the de facto leader of the N. C. A.; James P. Stoddard, General Agent and Lecturer of the N. C. A. from 1872 to 1890; and Edmond Ronayne, onetime Master of a Chicago Lodge of Masons.

The basic premises of the persuasion of the National Christian Association were: 1) that secret orders were anti-Christian; 2) that secret orders were anti-democratic; and 3) that political action was the most expedient means of combatting secret orders. Because of the religious character of the National Christian Association, the anti-Christian premise received the most emphasis.

Much of the proof for the premises above cited was drawn from the Bible. The "Biblical literalists" who comprised the National Christian Association found many passages from the Scriptures which they believed to mean that secret societies were evil. Additional proof came from former members of secret orders.

The public responses to this ambitious lecture program was apathetic. By 1882 the National Christian Association had largely abandoned the state and local lecturers, and had turned its attention to the literature of anti-secrecy. After 1882 the N. C. A. no longer attempted political action. Retrenchment became the watchword.

The National Christian Association exists today. The "hard core" reformers of 1868 revived the original anti-secrecy cause of 1830, supported it with extensive speaking leadership, and continue to lead it – a tribute to the dedication of its founding fathers.

The principal primary source of the activities of the National Christian Association were the Christian Cynosure, official publication of the organization, the correspondence and lectures of Jonathan Blanchard and other speakers of the organization, convention proceedings, tracts and lectures. The "Anti-Masonic File" of the Grand Lodge Library of Iowa (Cedar Rapids) also provided extensive materials. 312 pages. $3.90. Mic 56-1609

CITY LOW-LIFE ON THE AMERICAN STAGE TO 1900

(Publication No. 16,433)

Willis Lloyd Turner, Ph.D.
University of Illinois, 1956

This is a study of the use of city low-life themes, characters, and locales in the native drama and theater of the nineteenth century. It is an investigation of one aspect of our theatrical past, and an attempt to trace a theatrical tradition from its earliest beginnings to the end of the nineteenth century. In a more limited sense it is an investigation of one aspect of the struggle to establish a purely native drama, and of the role of "local dramas" in the rise of theatrical realism.

The impulse to give theatrical expression to lower class life in the city preceded the great growth of urban centers in the United States. A large body of nineteenth century plays was devoted to the treatment of local material, and to the social life of urban lower classes, while America was still predominantly a rural nation. Most of these plays have never been published, and only a few have survived in manuscript. Very few of them, if any, have literary value. From an historical point of view, however, such plays deserve more attention than they have received in the past.

Some of the more popular "local dramas" were published in French's Modern Standard Drama, Spencer's Boston Theater, and other collections of nineteenth century plays. Many of Edward Harrigan's dramas survive in manuscript in private collections. For the most part, however, for the purposes of this study, secondary sources and "fugitive material" – contemporary playbills, reviews, pictures, and the like, contained in the theater collections of the Harvard College Library and the New York Public Library; the standard histories of the American stage; and, in some cases, the sources of the plays in dime novels and story papers of the era – had to be relied upon in lieu of the scripts themselves.

The plays investigated illustrate a continuous chain of development over a period of nearly seventy-five years, reflecting to some extent the changes wrought upon the American urban scene and upon the theater from the time of Robert Montgomery Bird to the time of Edward Harrigan.

The initial models for dramas of city low-life were English, and the French drama later exerted a powerful influence both upon form and content. As the century advanced, a marked tendency to develop along purely native lines is evident. In 1848 Chanfrau and Baker created a distinctly urban American comic character type – Mose the fireboy – comparable to the stage Yankee and the stage frontiersman, in a vehicle emphasizing local satire. The story paper dramas of the fifties and sixties owed little to foreign models, dealing almost entirely with the romance of native cities. The spectacular melodrama of the post Civil War era placed less emphasis upon local character types, but continued to depict local scenes with increasingly realistic detail. In Harrigan's Theatre Comique the comic values of local character were rediscovered. Harrigan's drama stemmed chiefly from the native vaudeville stage and was so markedly different in form and content from the polite British comedies and romances then popular in other theaters that the author was hailed as an American Goldoni.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

Since many of the characters and settings depicted in the dramas of city low-life had real prototypes familiar to local audiences, the theatrical representation constantly invited comparison with reality. A conscious effort appears to have been made to imitate the models exactly, within the technical limitations of the theater.

It appears, therefore, that the plays were significant, not only in the development of native drama and theater, but in the development of realism in acting and staging as well.

215 pages. $2.69. Mic 56-1610

ZOOLOGY

CLASSIFICATION OF EGGS OF NEARCTIC AEDINE MOSQUITOES (DIPTERA:CULICIDAE)

(Publication No. 16,385)

George Brownlee Craig, Jr., Ph.D.
University of Illinois, 1956

1. Investigations on the bionomics and control of Nearctic aedine mosquitoes have been hindered by inability of workers to recognize these mosquitoes in the egg, the stage in which aedine species spend most of their lives. In order to facilitate investigations and to elucidate systematic relationships, eggs of species of Nearctic Aedes have been collected and examined in an attempt to discover characters of value in specific differentiation.

2. Eggs of mosquitoes have long been known to provide important characters for segregating smaller categories but little has been done on groups other than anophelines. Numerous descriptions of eggs of aedine species exist, but little effort has been directed toward systematizing this knowledge. Previous accounts of external structural features of eggs of Aedes have resulted in descriptions insufficient for indicating arrangements into groups of less than generic rank.

3. Development of newer methods for procurement and detailed examination of aedine eggs now allows ascertainment of characters sufficient for specific separation. In the present work, whole eggs have been observed, measured and illustrated by reflected light. By a modification of the technique of Horsfall et al. (1952), fragments of cleared chorion have been observed and photographed by means of optical systems using transmitted light and phase-contrast illumination. Eggs were obtained from ovipositions by wild-caught or colonized females and from material separated from field oviposition sites as well as from dissections of dried, gravid museum specimens.

4. Descriptions and illustrations of eggs of 35 out of 63 species of Nearctic Aedes including most of the more common forms are presented in this work. This list includes representatives of all the Nearctic subgenera of Aedes and six of the seven groups of the largest subgenus, Ochlerotatus.

5. Specific characters have been found for eggs of most of the species examined. Eggs differ among species according to shape, size and color, as well as texture and sculpturing of the layers which comprise the shell. Characters involving shape and structure of the cellular reticulation on the surface of the chorion are of particular assistance in segregating species. Relationships between the species are summarized in the form of a key.

6. Analysis of specific characteristics and affinities based on external structure indicates that eggs of Aedes fall into natural categories. These categories are similar to the arrangement of groups in the phylogenetic system of classification of Edwards (1932) which is based largely on characteristics of adults. Therefore, external structures of eggs appear indicative of phylogenetic relationships of aedine mosquitoes. Classification by eggs indicates certain exceptions to the system of Edwards. These exceptions give evidence of subspeciation and possible realignment of some subgeneric and group units based on external characters of eggs.

135 pages. $1.69. Mic 56-1611

THE FIT OF THE NEGATIVE BINOMIAL, NEYMAN A, AND POLYA DISTRIBUTIONS TO COUNTS OF CERTAIN CRYPTOZOA AND GRASSES OF PASTURELAND

(Publication No. 16,303)

Paul Jensen, Ph.D.
Cornell University, 1956

A number of well-known functions have been fitted to observed distributions of cryptozoic invertebrates censused on an upland pasture in New York State. The data were obtained on an experimental area divided according to a Latin square design in which the plots were subjected to various treatments designed to reduce or eliminate the snail, Cionella lubrica. To sample these populations, boards were distributed at random on the plots. The vegetation was removed from beneath each board and wet burlap placed on this denuded surface. Observations of pertinent weather factors were taken before each daily census.

The observed distributions obtained by this procedure were fitted with three functions: the negative binomial, the Neyman A and the Polya distributions. The effect of certain environmental factors on the aggregations of the animals making up these distributions was analyzed through use of the Charlier coefficient and it was shown that the state of aggregation of C. lubrica differed markedly in the variously treated plots.

Many distributions of C. lubrica obtained in both 1953 and 1954 were fitted by the above named distributions and found to be poorly described by these functions, particularly at certain elements of the distributions as evidenced

by accumulation of chi-square totals at these elements. The Neyman A did not describe the snail distribution at all in either year and further did not describe adequately any of the distributions of the other plants and animals censused. The other functions showed bias toward the frequencies at one, three and five snails per sampler. None of these functions fitted the more skewed distributions of the summer of 1954.

Distributions of Trachelipus rathkei for both 1953 and 1954 were fitted with the same functions. The observed distributions were all highly skewed and consequently poorly fitted by all three functions. The secondary modes produced in these distributions by family groups were not predicted by any of the distributions. A mode at two sowbugs per sampler, attributable to mating pairs, was also not predicted.

Among the distributions obtained, one, that of a lycosid spider, was found to be negatively contagious as might have been expected since this was a cannibalistic spider. Distributions of a number of slugs were also fitted by these same functions. None predicted the modes produced by family groups. The Neyman A described these data rather poorly.

Finally the distributions of culms (stalks) of a number of species of grass were fitted by these same functions. The Polya distribution barely described these data while the Neyman A and negative binomial give poor fits to the data.

A distribution developed by Cole was tested on parts of the data and found to give adequate fits where it could be used. This function had the desirable property of reproducing the modes so frequently observed to be due to family groups and sexual pairs.

82 pages. $1.03. Mic 56-1612

SOME OBSERVATIONS ON THE HISTOGENESIS AND HISTOPATHOLOGY OF ECHINOCOCCUS ALVEOLARIS (KLEMM), IN WHITE MICE

(Publication No. 16,411)

Sarojam Kurudamannil Mankau, Ph.D.
University of Illinois, 1956

White mice were used for experimental infections and 70 percent of all the animals used were successfully infected with Echinococcus alveolaris. In most cases liver was the focus of primary infection. The larval foci became evident a few hours after the infection by the cellular reaction around them. As the larva grows, more and more infiltrating cells surround the area and the larval focus can be detected macroscopically about 6 days after the infection. Lymphocytes, polymorphonuclear cells, fibroblasts and a few eosinophils are the predominating cells in the granulation zone around the larva. The primary larval vesicle undergoes exogenous and endogenous budding invading more and more of the host tissue. A laminated membrane becomes well developed surrounding the proliferating germinal membrane.

In the past, alveolar cysts were known to occur only in man and occasionally in the ox, and they were mostly sterile. But rodents appear to be more successful intermediate hosts for alveolar cysts. The cysts were totally sterile in only 30 percent of the infected mice. In the others, both fertile and sterile cysts were found to occur in the same cystic mass. In no case were all the cysts in a cystic mass found to be fertile. In the sterile cysts, the germinal membrane is relatively inactive and later undergoes atrophy and degeneration. The laminated membrane is often incomplete or broken and lies crumbled in the lumen of the cyst.

In the fertile cysts, the beginning of scolex production is observed only 3 to 4 months after the infection. Groups of loosely arranged parenchymatous cells are produced by the germinal membrane, which later become organized and develop into brood capsules. The scolices make their appearance as small bud-like structures within the brood capsule which later develop into infective scolices with well developed suckers and double rows of hooklets. The brood capsules, instead of being singly attached to the germinal membrane become multiple and usually fill the entire lumen of the cysts. The cysts contain very little or no fluid inside.

Lung, kidney, spleen, pancreas and the alimentary canal were also affected by the hydatid infection. A large portion of the lung was replaced by the cystic tissue and only a very few cysts were fertile. The inflammatory changes characterized by infiltrating cells were very similar in all these organs. The fibrotic changes caused by the cysts and the atrophy and degeneration thus produced are also more or less identical whichever be the organ infected. Perivascular mononucleosis is characteristic of this infection. Hemorrhage, congestion, fibrosis, extravasation of erythrocytes, and also necrosis, degeneration and atrophy of the cells were also prevalent in the infected areas. There was an increase in the number of myeloblasts and megakaryocytes in the spleen. Peribronchial mononucleosis was quite predominant in pulmonary infections. In some cases an increase in the amount of blood pigments such as haemosiderin and haemofucin was observed in the liver, but this was not found to occur consistently in all the infected animals. The chief characteristic that is unique in the larval stage of Echinococcus alveolaris is the type of lesion which behaves very much like an infiltrating neoplasm.

148 pages. $1.85. Mic 56-1613

AN ANALYSIS OF BIRD POPULATIONS IN RELATION TO PLANT SUCCESSION IN ALGONQUIN PARK, ONTARIO

(Publication No. 16,412)

Norman Duncan Martin, Ph.D.
University of Illinois, 1956

Study plots of about 25 acres each were laid out in each of the major forest types of Algonquin Park, and the vegetation was sampled on five percent of the area of each plot.

Although there is a great diversity in the tree species composition of the forests, there is a general pattern of forest succession. There is a hydrosere on wet ground and a xerosere on uplands. In the hydrosere, primary succession following Pleistocene glaciation is from bog to Picea mariana forest to P. mariana – Thuja occidentalis forest and finally to bottomland forest (Abies

balsamea – Alnus). In the xerosere, primary succession, according to pollen analysis, is from Abies balsamea – Picea glauca forest to Pinus strobus to hardwoods (Acer saccharum and Betula lutea) and Tsuga canadensis. Secondary succession, following cutting and fire in the xerosere, is from a pioneer forest of either Betula papyrifera – Populus tremuloides or Pinus banksiana to a secondary forest of either Abies – Picea or Pinus strobus to a subclimax of hardwoods and then to a climax of Tsuga. The time after a fire required for Tsuga to become primary dominant is estimated at 1100 years.

The most important factors in succession on wet ground may be lowering of the ground-water level and build-up of organic soil. In the xerosere, primary succession may be influenced mostly by changes of micro-climate and by differences in the shade tolerance of tree species. Secondary succession in the xerosere may result from the operation of seed source, soil properties, species growth rate, and shade tolerance.

Using the spot-map method, bird censuses were taken on each of the study plots during 1952 and 1953. Corresponding with forest succession, bird populations changed in a characteristic way. Each forest stage did not, however, contain a distinct bird community. Recognizable bird communities inhabited bog, boreal forest (Abies – Picea), Tsuga forest, and deciduous forest (Acer – Betula). Total bird populations were 286 territorial males of 13 species in bog, 232 territorial males of 32 species in boreal forest, 279 territorial males of 28 species in Tsuga forest, and 168 territorial males of 18 species in hardwood forest. Variations in stratal organization and relative conspicuousness of predominant species produced different facies of these bird communities within each vegetation type, corresponding with variations in species composition and structure of the plant community. The selection by bird species of plant communities was found to be generally consistent with other areas of eastern North America.

382 pages. $4.78. Mic 56-1614

A STUDY OF THE MOVEMENTS AND DEPTH DISTRIBUTION OF THE PELAGIC FISHES IN LAKE MENDOTA

(Publication No. 16,218)

John James Gowan Tibbles, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Arthur D. Hasler

This study was initiated to extend our knowledge of the movements and depth distribution of the pelagic fishes (perch – Perca flavescens (Mitchill), white bass – Lepibema chrysops (Rafinesque) and cisco – Leucichthys artedi (LeSueur)) in Lake Mendota using the U. S. Navy (Submarine Signal Co.) NJ-9 (21.6 kc.) echo-sounder.

A method of cruising on pre-determined courses was devised so that the movements and areas of concentration of fishes could be ascertained by the echo-sounder. The rolling gill net was developed for confirming echoes recorded on the sonar gear that were attributed to fish and for depicting the depth distribution of the pelagic fishes. The net, supported on a metal float, when set forms a curtain of netting from surface to bottom 18 feet wide by 50 feet deep.

Various aspects of the use of sonar gear were investigated as: plotting concentrations of fish-echoes; echo-sounding through ice; recording a "surface" scattering layer; perch behaviour during the spawning period; recording fish attracted by light; correlating surface echoes with schooling white bass at the surface and corroborating bottom echoes as fish by means of a small otter trawl.

The NJ-9, a relatively low frequency, echo-sounder was most efficient in recording fish-echoes in the upper 35 feet of water. The concentration of fish at the Second Point shelf was in an area where there was a gradual drop in depth. These fish appeared to move in a westerly direction in the morning, over the gradually sloping shelf, away from the shelf and return in the evening. All of the fish did not participate in this movement because echoes (although substantially reduced) were recorded in the same area throughout the day. These perch remained quiescent on the bottom at night and were not recorded with the echo-sounder.

There appears to be at least three behavioural variations in sites of habitat for perch in Lake Mendota during the summer: 1. The littoral population composed of juvenile and mature perch. 2. The population (chiefly mature) on the west side of the Second Point Shelf characterized by the rhythmic daily movements described above. 3. The population of older perch found on the east side of the shelf that are active 24 hours a day.

The depth distribution of perch, white bass, cisco, gar pike – Lepisosteus osseus Rafinesque, and northern pike – Esox lucius Linnaeus, was determined for one area east of the underwater shelf at Second Point, from late summer to early spring by means of the rolling gill nets. Over 90 percent of the white bass were caught in the surface 20 feet, while over 90 percent of the perch were taken below 20 feet in water 54 feet in depth. From the varying depths that perch were caught during the summer it is apparent that they are not restricted to a definite temperature stratum. It appears that the pelagic population of perch in Lake Mendota remain in the deepest water in which there is sufficient oxygen to maintain life.

209 pages. $2.61. Mic 56-1615

THE DISTRIBUTION OF SMALL STREAM FISHES IN MINNESOTA. INTRA-SPECIFIC VARIABILITY IN THE COMMON SHINER (NOTROPIS CORNUTUS), THE SAND SHINER (NOTROPIS DELICIOSUS), AND THE BIGMOUTH SHINER (NOTROPIS DORSALIS). (PARTS I AND II)

(Publication No. 15,966)

James Campbell Underhill, Ph.D.
University of Minnesota, 1955

Fishes were collected in the small streams tributary to the St. Croix, Minnesota, lower Mississippi and Missouri rivers in Minnesota. A total of 100 collections were made in 1952, 1953 and 1954. The distribution of the 41 species of minnows and 14 species of darters, as well as one ameiurid and one sucker was discussed. In plotting the distribution, the collections at the University of Minnesota were used. Relative dates for migration were

assigned to various groups of species based on the late and post Mankato chronology. Seventeen species of minnows and 3 species of darters were common to all drainage basins, while 13 species of minnows and 2 species of darters were restricted to the lower Mississippi River basin. Biological evidence was presented which indicates that the upper Mississippi-St. Croix connection was open for a time following the closure of the Lake Duluth connection. Evidence was presented which indicates that there was no important barrier to fish dispersal in the St. Croix River. The upper St. Croix fauna includes 8 species of fish absent from the upper Mississippi River. Seven species of fishes common to the Minnesota River are absent from the Red River basin, indicating their migration in post Lake Agassiz-River Warren time. The distribution of only two species of minnows could not be explained on the basis of a lower Mississippi origin in post or late Mankato time. The distribution of the finescale dace and the creek northern chub, seem best explained on the basis of an eastern and western refugium in Wisconsin time. Following deglaciation the eastern populations expanded through the Great Lakes and western populations from the Alaskan refugia migrated eastward by way of Lake Agassiz. The distribution of all but one species of minnow could be explained in terms of late and post Mankato events. The above species, the stoneroller, has a rather restricted range in the upper Mississippi River and it is considered to be a recently introduced species, possibly in minnow dealers stocks. Ecological factors limiting fish distribution were discussed, but it was impossible to determine what the limiting factors might be, since essentially similar habitats were present in many of the drainage basins. Those species restricted to the lower Mississippi River were considered to indicate late migrations, rather than ecologically limited species, similar habitats occupied by these species in the lower Mississippi River were to be found in the St. Croix and Minnesota rivers.

Intraspecific variation in certain meristic characters in three species of small stream fishes were studied. The sand shiner, Notropis deliciosus, exhibited the least variation, the common shiner, Notropis cornutus, exhibited an intermediate level of variation and the bigmouth shiner, Notropis dorsalis, exhibited the highest level of variation relative to that exhibited by the sand shiner. The interpopulation variation exhibited appeared to be related to the habitat specificity of the species; Notropis dorsalis being restricted to small sandy streams showed the greatest variation, while Notropis deliciosus being the least restricted showed the least variation. Populations from different drainage basins were significantly different from one another in certain characters, but populations from the same drainage basin were also significantly different from each other. This indicates the presence of microgeographic races within a single basin and reduces the significance of inter-basin differences. There was no evidence of sexual dimorphism in any of the characters studied, though there was evidence of marked annual variation in certain characters in the bigmouth shiner. These annual differences could not be correlated with climatic differences in the three year period. The differences found to exist between populations from neighboring streams in the same drainage basin, seemed most easily explained on a genetic basis, rather than by postulating environmental differences where none were apparent. The differences found between populations were interpreted as a reflection of genotypic differences between the various populations. The genetic control of the characters studied has yet to be established.

225 pages. $2.81. Mic 56-1616

AN EXPERIMENTAL STUDY OF THE ROLE OF THE GONADS IN THE ANNUAL STIMULUS FOR BIRD MIGRATION

(Publication No. 16,437)

Charles Martin Weise, Ph.D.
University of Illinois, 1956

Recent investigations have elucidated the physiological changes associated with migration in birds. These changes are thought to be under the immediate control of endocrine mechanisms which are in turn related to annually recurring changes in the environment. The present study is an attempt to determine the role of the gonads in the endocrine mechanisms governing spring migration.

To establish criteria for distinguishing the migratory condition in captive birds a group of white-throated sparrows (Zonotrichia albicollis), tree sparrows (Spizella arborea), and a junco (Junco hyemalis) were kept in an outdoor aviary for almost two years. These exhibited seasonal changes in body weight, fat and molt similar to those of wild birds of these species, and it was inferred that the observed activity levels (as recorded mechanically) and metabolized energy levels were also representative of those of wild birds. It was concluded that the following are indicators of the migratory condition: (1) rapid deposition of fat, especially peritoneal fat; (2) a corresponding increase in body weight; (3) nightly unrest, or Zugunruhe. Of these nightly unrest is most valuable since in these outdoor birds it was most strictly confined to the migratory periods and its intensity varied with changes in air temperature and weather in the same way that migratory movements of wild birds are reputed to vary. The nightly unrest behavior pattern appears to be a modification of the nocturnal flight behavior pattern of wild birds.

Experiments concerning the gonads were conducted with white-throated sparrows indoors at controlled temperatures and photoperiods. Three males were successfully castrated while their testes were in the winter condition; these failed to gain weight or fat or to exhibit nightly unrest within six weeks after a change from short to long photoperiod. Thirteen sham-operated controls gained weight and fat rapidly in the third to fifth weeks after the photoperiod increase, and showed strong nightly unrest after the third week. Five supposedly castrate birds regenerated gonadal tissue; these responded slowly at first but by the end of the sixth week were approaching the weight, fat and nightly unrest levels attained earlier by the controls. These differences in response were significant at the five percent level when tested by an analysis of variance.

Three males were exposed to a photoperiod increase first and then castrated when the migratory responses had begun to develop. After castration these lost weight and fat gradually and nightly unrest ceased. One male, kept at a constant short photoperiod, was treated with pituitary gonadotropin. This resulted in testicular enlargement but not in any of the responses indicative of the migratory condition.

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A few birds were treated with thiouracil, Armour beef growth hormone and diethylstibestrol in an attempt to induce fat deposition artificially, to determine if this alone would initiate nightly unrest. Fat deposition was not induced by thiouracil or growth hormone. Stilbestrol treatment resulted in some weight gain, without visible fat deposition, and nightly unrest in two of four male birds. It is uncertain whether these represented the migratory condition. It was observed that stilbestrol treated males gained weight and fat very rapidly after a photoperiod increase.

This evidence indicates that gonadal recrudescence is involved in the development of the spring migratory condition. However, gonadotropin-injection experiments and many general considerations concerning bird migration preclude a direct involvement. It is hypothesized that in castrate birds the gonadotropic activity of the anterior pituitary is intensified, to the detriment of other pituitary functions which govern fat deposition and ultimately migratory behavior.

134 pages. $1.68. Mic 56-1617

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